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ILLUSTRATIONS.

Design for New Admiralty and War Offices by Messrs. Hall & Powell: Whitehall Front 490-491
Ground and First Floor Plans of Messrs. Hall & Powell's Design for New Admiralty and War Offices 494, 495
New Lych-Gate, Bexley Old Church.—Mr. William Rickwood, Architect 498
Pulpit, St. Saviour's Church, Paddington.—Mr. F. B. Wade, Architect 499
Plan and Details, St. Leonard's Church, Middleton, Lancashire.—Measured and Drawn by Mr. E. W. Leeson 502-503

CONTENTS.

Bricks, Tiles, and Terra Cotta 479
"To Surveyors and Others" 481
Excavations at Piedimonte D'Alife 482
Notes 482
The Vagaries of a Waterway 483
The Sanitary Congress at Dublin 485
Stoves and Grates at the Health Exhibition 487
Architectural Association 488
Competitions 488
Design for Admiralty and War Offices: By Messrs. Hall & Powell 488
Lych Gate 488
Pulpit in Wrought Iron 488
St. Leonard's Church, Middleton 488
The Wall as an Architectural Feature 505
The International Forestry Exhibition, Edinburgh: Concluding Notice 506
Lectures on Architecture at the Crystal Palace 506
Recent Patents 507
The School Board for London 508
The Southwark and Vauxhall Water Company's New Works at Streatham 508
Decoration of St. Paul's 508
Sewer Ventilation 508
Surveyorship of the Parish of Chelsea 508
Zinc Roofs 508
"Architects' and Contractors' Handbook" 508
Church-Building News 508
Dissenting Church-Building News 509
The Student's Column: On the Construction of Floors.—II. 509
Bronze Alloys for Engineering Purposes 510
Modern Mummies 510
Miscellanea 510

Bricks, Tiles, and Terra Cotta.

MR. DAVIS'S work on the manufacture of bricks, tiles, and terra cotta* in every respect bears out its title of "A Practical Treatise," and is eminently characteristic of the nationality of its author, for it deals only with the practical side of the art on which it treats, and enters into the minutest details of the various branches into which that art is divided. We have hitherto flattered ourselves that as a nation we had pretty well mastered the art of brick-making, however short we may have come in the manufacture of the finer descriptions of pottery, but a perusal of Mr. Davis's work shows that we have yet a good deal to learn in all the various processes through which a brick has to pass before it arrives at the proper degree of perfection for the particular purpose for which it may be required. While admitting, however, that in this special class of our manufactures there may yet be much to be desired, we hope Mr. Davis's anticipations are not likely to be realised, that it has reached its highest standard, and will henceforth have to give way before the superiority of American art, and that Staffordshire is destined to become the *entrepôt* of American tiles, as Liverpool is of American meat. "Sending tiles to Staffordshire may seem to the majority of Englishmen as a wild improbability, but ere long that fact will be established," writes our author; but the fact which he assigns as aiding to this end is not usually understood as "too entirely dominating the English mind," viz., "a tendency to lower the high standard of wares, and produce something cheap." We are accustomed, on the contrary, to attribute this failing to our cousins, and to wonder how it can ever be worth while to produce even, much less to export, the number of cheap trifles which are exhibited in the special "notions" shops to be found in some of our principal streets. There can be no doubt, however, as to the rapid strides which America has made in ceramic art, and there are many valuable hints and facts to be gathered from Mr. Davis's work, which as a whole, cannot fail to be appreciated in this country, embracing as it does the entire field of manufacture, from the simple plain wall-brick to the artistically-ornamented encaustic tile or terra-cotta ware.

* "A Practical Treatise on the Manufacture of Bricks, Tiles, Terra Cotta, &c." By Charles Thomas Davis. London: Sampson Low, Marston, & Co. Philadelphia: H. C. Baird & Co.

It would scarcely be supposed that so prosaic a subject as that of brick-making could offer attractive material for history; but the first chapter in the book contains much which is interesting even to the general reader. In it is traced the manufacture from its commencement on the plains of Shinar, when the descendants of Noah in 2247 B.C. said "Go to, let us make bricks and burn them thoroughly," through the period of Israel's bondage to their Egyptian task-masters, down to the age of Grecian and Roman dominion, along Mediæval times, and ending with the present day. During the first two centuries of the Christian era, the art under the Romans appears to have reached perfection, only afterwards to decline until the fifteenth century, when it revived, as evidenced in England by such specimens as the Lollards Tower and Hampton Court; and in Italy, in the beautiful brickwork and elaborate ornamentation of its ecclesiastical and palatial architecture. In Holland, however, brick was the chief building material from the earliest times, and it was under the direction of a Dutch Governor seemingly that bricks were first used in the construction of houses in America; but it was not until the eighteenth century that they were brought into common use, and then only such as were imported from England. For some time America appears to have made but little progress in the art; "but," adds Mr. Davis, "at the present time, for both quantity and quality, we have no equal in any nation of the world," being indebted, in his opinion, for this position "to the American patent system, which greatly fosters and encourages development in this line, as in other and kindred arts." That the patent system of Great Britain is faulty is generally acknowledged, and steps have recently been taken for its amendment, but it is questionable whether its defects are answerable for all the results attributed to it by Mr. Davis, and whether the machines for the production of bricks described in the volume, and which are said to be fruits of the superior American patent system, "evidences of a high civilisation" though they may be, yet deserve to be considered "as but tokens which are in time to place the manufacturers of the world under American control." Mr. Davis, however, discusses the conditions of the amended Patent Law, and while admitting that some of its points are worthy to be copied, yet describes it on the whole "as too much a relic of a period which is long since past," and the general conclusion at which he arrives is that a nation which adheres to antiquated ideas and customs must give place to the one whose new-born energy is continually causing it to develope its ingenuity in new and varied directions. The argument would have weight if the premisses were correct, but the fallacy consists in the assumption of our adherence to an obsolete past. That necessity stimulates the faculty of invention is undeniable, but it is this very necessity, engendered by the keen competition of the present day, that is acting on the English inventive faculty, just as it has done in America, and is daily calling forth in this country discoveries in science, and improvements in manufactures such as have never before been witnessed, and which will continue to keep Great Britain in the van amongst the nations of the world.

Before describing the processes or the machines employed in the manufacture of bricks, the author devotes a chapter to a description of the various clays, and of the changes they undergo under the several conditions to which they are subjected, justly observing that a thorough knowledge of the clay to be employed in any particular manufacture is essential to insure a successful result. It sometimes occurs that clays are found satisfying all the conditions necessary for turning out good bricks, but more often the earth requires an admixture of other material, or else has to be specially treated in order to get rid of substances which are hindrances to the production of even a passable quality of building bricks. The proper way of overcoming these and other difficulties is clearly explained, and the various methods to be employed in dealing with the different descriptions of argillaceous earth that are suitable for brick manufacture are minutely detailed. The efflorescence, commonly known as "salt-petering," that is so often to be seen on buildings and walls is a phenomenon better known than understood. It is remarkable that during the autumn of 1882 more of this efflorescence was to be seen upon buildings on both sides of the Atlantic than had appeared for many years; old structures as well as new, and those in process of construction, such as the Technical College at South Kensington, being covered with it. "The question of what this efflorescence was, and its cause was investigated by various scientific societies, the Academy of Natural Sciences in Philadelphia discussing it at length; and the substance of their decision was that it was simply ordinary Epsom salts or sulphate of magnesia, which dissolved in the water passing over the bricks, and in evaporating left the deposit; the sulphurous acid, resulting from burning coal, combining in the presence of moisture with the magnesia in the mortar and forming the salts." Various other theories have been set forth as to its origin, but Mr. Davis adds that "there appear to be certain conditions which facilitate the production of the saltpetre, viz., a degree of humidity about equal to that of

garden earth is very favourable; between 60 deg. and 70 deg. Fahr. vitrification is the most abundant; at 32 deg. it does not take place at all." Whatever the cause of it, however, there is no doubt but that it should, as urged by the author, "render the research into it highly interesting to the architect and the builder, on account of the disagreeable effect it produces upon decorations, internal as well as external, and of its action in greatly lessening the durability of stone," an instance of which occurs in the Houses of Parliament. It is well known to engineers, however, that its appearance is not always due to the bricks, but that it is often owing to the ingredients of which the mortar has been composed; and hence, probably, its effect upon buildings erected or faced with stone.

While on the subject of clays, mention is made of the earth described by Strabo A.D. 24 as found at Pitane in the Troad, from which bricks were made so light as to float upon water. For centuries the art was lost until rediscovered by Giovanni Fabroni, in Tuscany, in A.D. 1791, who succeeded in making such bricks, the strength of which at the same time was but little inferior to that of ordinary building bricks. One remarkable peculiarity possessed by them was that of being very poor conductors of heat, as they could be held by one end with the bare hand while the other was red hot,—the practical use to which that property could be turned being illustrated by the experimental construction of a powder magazine on board a wooden ship, which, being set on fire, sank without explosion of the powder. There are several purposes to which these bricks can be profitably applied, such as the fireproofing of floors, ceilings, and roofs,—and notably in the construction of walls in substitution of the frame partitions now commonly used in the upper stories of lofty buildings for the sake of lightness, wherein economy is studied at the expense of security against fire. Hollow bricks of this description, it is suggested, would be sufficiently light to be easily supported by the iron girders now used wherever large spans of floors are required to be partitioned off, while the advantage of diminishing the danger from fire would lessen the rate of insurance, not only on the building but on the stock it contained, and so, probably, be a sufficient set-off against the increase, if any, in the cost of construction.

A common practice in this country, viz., that of mixing ashes in large quantities with the clay, with the view of gaining time in the burning, is severely condemned by Mr. Davis, not only as rendering the bricks "very porous, greatly weakened, and generally shaky," but as causing an intolerable nuisance to the whole neighbourhood where the kilns are in operation, and a serious source of injury to the health of the inhabitants in the nauseating fumes given out from the various substances which are mixed up in the "soil." That the odours arising from brick-kilns are unpleasant is unquestionable, but they are not generally understood to be injurious to health. No doubt, however, that the practice is rightly condemned, and that brickmakers would consult their interests best by abandoning it. Some interesting particulars are given as to the strength of different descriptions of bricks, and perhaps few people are aware of the enormous pressure that the best quality of hard-burned bricks are capable of bearing. Mr. Davis states that, according to tests made by the direction of an officer of the United States army, the bricks used in the erection of the Pension Office at Washington stood a pressure of from 6,050 lb. to 10,290 lb. per square inch, or from 420 to 700 tons to the square foot, "which is more than good granite, and three times as much as good building stone will stand." In comparing the merits of dry and damp clay, preference is given to the latter, for the reason that "the nearer clay approaches the plastic condition when moulded into bricks, the better will be the stock produced; for when clay is dried before being moulded it is impossible to produce a strong brick, the particles of clay will not agglutinate under pressure, and in the kiln the heat will pass through the brick and not be so effective as in a damper and denser made brick." Not only so, but "it will require 25 per cent. more fuel and longer time to burn the dried clay brick than the one made with damp clay," a fact which is probably not known to many manufacturers. Much valuable information follows in the two sections of Chapter III. on the process of enamelling and glazing bricks and tiles, earthenware, &c., and on the various substances used for the purpose, accompanied by some illustrations of ornamental bricks produced by the Peerless Brick Company, of Philadelphia.

A couple of chapters are devoted to the manufacture by hand and by machines, in which the details of preparation of the clay, and of the processes of tempering, moulding, drying, conveyance to the kiln, and burning, are minutely described and discussed. Mr. Davis claims for the bricks manufactured in Washington and its neighbourhood a superiority over any and all others in any part of the world for "strength, uniformity in colour, as well as in size, good edges and corners, and for all other reasons that can be named," alleging as the reason for this "that the enormous quantities of bricks consumed by the United States Government and the local Government have in both cases to pass the inspection of Engineers of the United States Army, or of experts employed for the purpose." We doubt if English manufacturers are prepared to admit such a claim, and shall be greatly surprised if equally good samples of every kind of brick that is made are not to be found in this country. At the same time, unquestionably many improvements appear to have been introduced in the American machines and modes of manufacture, which, if not already known in this country, will soon be appreciated and adopted. Amongst other minor articles is a pattern of brickyard barrows so constructed as to be easily folded up for transportation, to be used wherever needed in the construction of tunnels, culverts, on lines of railways, or other purposes.

The hints given on the burning of bricks, with the improved designs for kilns, are invaluable, inasmuch as they are the results obtained from actual working, the arrangement of the flues being especially noticeable as calculated to effect a more regular and equable diffusion of the heat than takes place in the kilns in ordinary use in this country.

Perfect, however, as hand-made bricks are, yet the enormons demand which has arisen consequent on the development of railways and extension of public works generally has rendered the introduction of brick-making machinery a necessity, and has called forth much ingenuity in the construction of machines for saving labour in the moulding of bricks from the crude clay. Of these machines there are two classes,—one employing moulds, into which dry clay is forced and shaped; the other, in which moist or plastic clay is forced through a die in the pug-mill in a continuous string, and cut off by some arrangement to the requisite size. The author is of opinion that bricks produced from dry-clay machines are unsuitable for engineering construction, though they may be used for architectural purposes, but inasmuch as their porosity is considerable, and they consequently absorb moisture very readily, it is necessary to be very careful in their selection, especially for buildings which are to be devoted to public speaking or to music, for dampness in walls affects the acoustic property of rooms by conducing to a great reverberation and confusion of sound. Consequently much importance is attached to the drying of bricks thoroughly. This operation is carried on in America by means of steam-driers, the use of which, besides effecting great economy in the after consumption of fuel in the kilns, saves handling the stock twice,—once in the "packing," and once in conveyance to the kilns. "The cost of coal to dry bricks artificially is therefore much more than saved by the economy of labour, while the amount of fuel to burn the bricks is less because they have been more thoroughly dried than by the open air." Hence, it is asserted, "the expense of artificial drying is less than that of sunshine." There is also the additional advantage of being able to keep the establishment employed in all weather, and throughout the whole instead of only a portion of the year, "but," adds our author, "these advantages sink into insignificance when the superior quality of the bricks is considered."

The chapter devoted to fire-clays, fire-bricks, and other products affords much valuable information, especially as to the composition and varied constituents of fire-clays, a point, however, on which the practical brickmaker does not usually much trouble himself, being content with that material which yields the best results in actual use. It is here that the dry-clay machines are invaluable, as the quality required in fire-bricks is not strength, but resistance to heat, a property which is secured by severe pressure producing tenacity of texture, the best condition for assisting vitrification. Illustrations are given of several machines for the treatment of fire-clays and for working them into any desired degree of fineness, one of the best being an arrangement of elliptical rollers by which the material is subjected to a *rubbing* action between their impinging surfaces. Amongst other purposes to which fire and terra-cotta clay has been applied, an instance is quoted of the columns which have been constructed in the United States Peruvian office for supporting the galleries which run entirely around the interior of the building, which is 400 ft. long by 200 ft. wide. The columns are bricks in sections 6 in. thick, laid in Portland cement, in which material the bottom section is carefully bedded, being encircled with a cast-iron rim, and forming the base of the column. When finished, the whole is cemented over with the same cement kept damp for several days to prevent its drying too rapidly. In the same building hollow fire-clay tiles are used for the floor-arches and ceilings, an 8-in. tile arch, with a span of 5 ft. between the beams, sustaining a weight of 2,000 lb. per square foot of floor. General Meigs, of the United States Army, who is superintending the construction of the same building, has carried out a series of tests as to the resistance of terra-cotta sheathing-tiles to a superimposed weight, which was applied to the middle of the tiles, the edges of which were supported so as to leave a clear span of 22 in. "Tiles of pure clay sustained a weight of 2,394 lb. before yielding, while those of mixed clay and sawdust gave way under a pressure of 1,940 lb."

The seventh chapter in the book is devoted to terra cotta, and opens with the following interesting remarks as to its durability:—"Many early productions, even of less durability than those now made, are found in ruins of stone, in which the latter material has been steadily disintegrating for thousands of years; but leaving the terra cotta as perfect, in many cases, as if recently produced. In faithfully-made and vitrified terra cotta we have the great and only lasting triumph of man over natural productions; for timber will rot; stone, even granite, will disintegrate; iron will oxidise. These and all other metals will succumb to the action of fire and other destroying influences of the elements; but properly-made and thoroughly-burned terra cotta will pass through the centuries and be the last to yield to those influences to which all natural productions must give way, the material being not only absolutely fire-proof, but also, in all architectural employments, practically time-proof and indestructible. Bank-notes, notes of hand, deeds of property, private transactions, public records, and many things of this character, have been and can still be found in a good state of preservation among the ruins of the great city, ancient Babylon, but they are not in the shape of perishable paper or parchment, but in the indestructible terra cotta." The application of terra cotta to many purposes and in many designs is clearly explained, but the character of design and the manner of treating it are well said to be subjects for much thought, and a true piece of criticism is conveyed in the following sentence:—"Truth is an absolute necessity in all terra-cotta designs, and as a desire for real in the face of sham materials is the cause of its revived use, why should the object of its employment be defeated" by using it so as to imitate other materials? One use to which terra cotta has been turned in

America is the manufacture of "lumber," by mixing resinous sawdust with the wet clay, which is left porous after the burning by the sawdust being consumed. After being treated in the mill, compressed, dried, and finally burned, it is planed, tongued, grooved, or sawn into any desirable shape, and is capable of being applied to a variety of uses. It can be united like joiner's work, or nailed into place like so much wood. It has been used for filters on waterworks, and, as a good insulator, being easily made water-proof, it will probably be utilised for underground telegraphy. If all that is stated of it turns out to be correct, the New York Terra-cotta Lumber Company has seemingly a brilliant future before it.

The next chapter is occupied with the manufacture of roofing-tiles and sewer-pipes, and contains minute descriptions of the various labour-saving machines which have been invented and are in use in America, and, with reference thereto, certain remarks are made with regard to the unreasoning objection of labouring men to machinery which deserve to be quoted in full :—

"Machines stimulate business, add increased interest to all pursuits, concentrate the hours of employment, and it is only from this source that the hours of labour which the working-men in all countries are trying to curtail, can be successfully reduced, and all the wants of mankind supplied at the same time. From the start, working-men have directed their influence against labour-saving machinery ; but in defiance of their efforts against it good has resulted to them in spite of themselves. Would they like to go back to the old hours of labour, from sunrise to sunset, live as they did then, and do without the advantages of education to themselves and children, now so common in this country ? Cheap homes, food and raiment, as well as cheap books and other sources of knowledge are the results of labour-saving machinery."

The manufacture of roofing-tiles and sewer and drain pipes has reached a pitch of such excellence in this country that it is doubtful whether it is surpassed by that of any other country, and whether England has anything to learn in this respect ; so also with ornamental tiles, which form the subject of the concluding chapter of Mr. Davis's work. We have already alluded to his expectation that America is to supplant the rest of the world in this as well as other branches of manufacture, and excellent as some of the pottery out-turn of that country may be, we certainly cannot agree in the assertion which claims for it a superiority over English manufactures, or that "English art in the whole line of artistic pottery has reached the highest points of development that it can ever attain under the present constitution of its society, and, what is more, it has been stationary, but is now on a decline." A visit to any of our principal potteries would be sufficient evidence that our author's assertion is incorrect. While quite ready to acknowledge the wonderful inventive faculty exhibited by Americans, and the exceedingly practical results attained by it, we scarcely think the time has yet arrived for the displacement of English for American machinery. It is certainly with great interest that we look forward to the Exhibition of Inventions which has been promised for next year, and hope that we may have an opportunity of seeing for ourselves specimens of all the ingeniously-designed machines which Mr. Davis's volume contains, and we feel sure that whatever merit they may be found to possess will meet with a full appreciation by British manufacturers in every trade ; we would meanwhile commend Mr. Davis's volume to all who are interested in the subjects which it so ably treats.

Caseine for Sizing.—An albumenoid substance may be used for paper sizing, but the albumen extracted from eggs or blood is too expensive for general employment. Caseine from milk has been substituted for egg albumen, by M. Muth, of Carlsruhe, for it has the same chemical composition. It is but slightly soluble in pure water, but may be wholly dissolved in water that is slightly alkaline.

"TO SURVEYORS AND OTHERS."

IT is, unfortunately, a well-known fact that for some considerable time past there has been so great a depression in public works that a large number of engineers and surveyors have had little to do, or have been out of employment entirely. Never do we remember having known Westminster to be so dull. It is a sad reflection that so many well-educated men, who have devoted considerable time and money to qualify themselves for an honourable and distinguished profession, should now have to realise that the market (if we may so call it) is glutted, and there is little or no scope for their abilities. India and the colonies are overflowing, and only in countries of questionable climate does there seem any chance of work. Public works in England have assumed such formidable proportions that with the present condition of affairs little remains to be accomplished for which there is not more than an ample supply of technical skill, whilst on the Continent a vast field of engineering enterprise seems to be stagnated by the clouded state of the political horizon.

We do not wish to appear to take a lugubrious view of the aspect of affairs ; indeed, we earnestly hope that the day is not far distant when public confidence may be restored, and a fresh impetus given to all branches of industry. In the meantime, parishes wanting surveyors appear determined to have a high time of it, and to ride rough-shod over unemployed talent. An advertisement will appear in which application is invited from qualified professional men to fill the post of "Surveyor and Inspector of Nuisances," the fortunate aspirant being required "to devote the whole of his time to the duties of his office." He must "be competent to prepare plans, specifications, quantities, and estimates for, and to superintend the construction and carrying-out of, any sewerage, water-supply, or other works, which may be required in the district ; also to perform all the duties of an Inspector of Nuisances, as prescribed by the order of the Local Government Board."

It is further stated that the district over which this enviable officer will have jurisdiction comprises thirty-three parishes, and he will require to keep a horse. Salary, 200*l.* per annum, to include all travelling and other expenses, excepting postage and stationery. Here, at least, is one chance. In the number of those of whom we have spoken, only thoroughly-qualified men of unquestionable ability will stand the slightest chance of securing such a prize, and to avoid any possible disappointment to many who may apply, we propose to briefly glance at what we suppose is expected. The candidate should be an excellent mathematician (a University man preferred), have regularly served his articles with an eminent civil engineer, should have subsequently been engaged upon some of the principal public works in the kingdom, whilst a Continental experience, with a knowledge of several languages, would augment his chances. He should be able to prove to the satisfaction of the Board that his knowledge of water-supply and sewerage is of so advanced a character that, if needful, he could prepare a scheme for the new water-supply of the metropolis, whilst to meet the outcry against the present state of the Thames he is capable of formulating an entirely new scheme for the disposal of the metropolitan sewage. In fact, his experience and abilities should be of so high an order as would enable him at a moment's notice to assume the joint duties of engineer to the City and Metropolitan Board of Works. This is in no way an exaggerated view of the standard which is frequently set up by local magnates who may be in want of a surveyor, and we venture to think that if a record had been kept of the proceedings of various municipal and other authorities upon such occasions the *vivâ voce* examinations of the select few applicants by members of the Board would clearly substantiate all we have said.

We have occasionally heard accounts, half humorous and half pathetic, of the interviewing of such a candidate by the authorities. Out of several hundred applicants, if he has exceptional testimonials (or, what is better, local influence) he may be one of the fortunate number,—selected for further consideration. And here we may say that, in one instance, an enterprising competitor conceived the happy idea of having his testimonials printed in chocolate ink upon toned paper, with his photograph as a frontispiece. Little attentions like these go down very well with some of the local authorities, who, being butchers, horse-dealers, &c., may be considered fair judges of appearances, possibly more so than of the highest testimony of qualification. Upon a certain date, the "select" are invited to attend a meeting of the Board, where, assembled in solemn conclave, are the intelligent representatives of local constituencies, by whose judgment the important office of surveyor has to be filled. In alphabetical order "the select" are called into their august presence, and it generally happens that amongst their number is a well-to-do builder, a retired cheesemonger, an enterprising ironmonger, or a fairly-informed stationer, who takes a leading part in the affairs of the place, and who either by assumption or general consent constitutes himself the mouthpiece of this collective authority, by whom the candidates are one by one severely interrogated as to their experience and abilities. Now and then some of the other members are bold enough to interpose a question. On one occasion a local shoemaker requested to be informed how much water a wind-mill could pump in a year ; whilst another member of the Board seemed anything but satisfied with the answer to his query as to what size drain-pipe should be laid down a street he had never seen. It was the candidate's first visit to the town, and upon his replying that it was necessary to know the length and fall of the street, and the number of inhabitants at present and in prospective, a very ominous look of incredulity passed round. One intelligent stationer, doubtless availing himself of the facilities of his business, had armed himself with one of Weale's rudimentary books on well-sinking, but the difficulty he experienced in understanding it himself,—and the still greater one the candidate laboured under in understanding what he meant, rendered the case of the latter far from satisfactory. In fact, by not endorsing the theory that water will flow up hill, the said candidate effectually forfeited all claims to have abilities of a character to attain the standard which this gentleman had fixed in his own mind as necessary, and the gentleman with his testimonials upon toned paper and illustrated by his photograph was successful.

It appears that whilst applicants for surveyorships are expected to know and do everything, the real gauge of qualification, in the eyes of many local authorities, is that he should be as "little of the gentleman" as possible. A man of manner and address, bearing evidence of good education and social status, seldom stands much chance with these local magnates, who, even if he be successful, take particular pleasure in snubbing and hurting the feelings of their more intelligent officer ; and, in order to maintain anything like a position in his office, he must divest himself of everything that can possibly bear sign of culture. After paying for interest upon capital for the purchase of the horse (which, with thirty-three parishes to supervise, seems indispensable) and its keep, with travelling and other expenses, the surveyor will have the satisfaction of devoting all his time and abilities, at the "beck and call" of over-exacting employers, for less than *three pounds a week*. Here is a pointed answer to the question of "What to do with our boys ?" Possibly the advice of our humorous contemporary upon the important subject of matrimony will be the best we can give to those of our professional brethren who comtemplate applying for such an appointment ; "Don't."

New Town-hall, Eastbourne.—The first stone of this building was laid by Lord Edward Cavendish, M.P., on the afternoon of Thursday last. Mr. W. Tadman Foulkes is the architect.

EXCAVATIONS AT PIEDIMONTE D'ALIFE.

IN the central valley of the Volturno lies the small mountain village of Alife, built approximately on the site of the ancient Samnite town of Allifæ, the seat of a pre-Roman civilisation. For years past it has not infrequently happened that peasants at work in the fields have lighted on ancient graves and turned up pottery, coins, and even gold ornaments: hence the place is known locally as "La Concha d'Oro." Fortunately for science, this ancient site has recently fallen into the hands of an intelligent man, Giacomo D'Egg. A woollen manufacturer by trade, he employs his leisure hours in superintending careful and exhaustive excavations. These during the past summer have been rewarded by large finds, to which several points of special interest attach. The graves opened are, doubtless, of widely different ages. Sometimes the dead bodies appear to have been simply thrown into the earth without any tomb whatever; sometimes the graves are tiled; sometimes huge coffins are found hewn out of tufa. One uniform burial custom distinguishes all the graves. In the mouth of the dead man is placed a small silver coin; in the right hand is held, or on it is laid, a shapeless copper piece, the raudus, or aes rude. There would be nothing surprising in finding the raudus in the same grave with the silver coin, as the old-fashioned money lingered on long after the new coinage became current, but the fact that the two appear uniformly together, and arrayed always in the same manner, is noteworthy, and seems to point to some ritual custom hitherto unobserved. The matter deserves the attention and investigation of archæologists. The silver coins found have in themselves a further interest, but of forty-three found by Sig. D'Egg, seven belong to Allifæ, twenty-three to Phistaleia, only one to Naples, twelve are yet undetermined. About the *locale* of Allifæ there is no dispute; but controversy has long raged among numismatists as to where the ancient Philisteia stood. Opinion has, on the whole, inclined to placing it on the coast in the neighbourhood of Cumæ. Numismatists have been influenced by the fact that a dolphin, the current symbol of a seaboard town, appears in the coinage type. Signor Minervini has, however, constantly maintained that Phistaleia was situated in the heart of the Samnite mountains. It appears from these recent excavations at Alife that his opinion, which coincided with local tradition, was most nearly, though not quite, right. We can no longer doubt that, when so large a find of Phistaleia coins is discovered near the Samnite town of Allifæ, Phistaleia itself was not far distant. Her coins do not appear except quite occasionally in the necropolis of Capua, where they would assuredly have been found had Phistaleia been situated on the sea-coast. The town then stood not indeed in the heart of the Samnite country, but in the outlying slopes in the middle valley of the Volturnus. The vexed question is thus happily set at rest. But these excavations have a great interest to the general student of ancient art as well as to the numismatist. We are only just beginning to feel our way in the quest of the earliest Italian, *i.e.*, of pre-Roman art. The excavations provide an invaluable store of new material. From the inscriptions in Oscan characters on the coins, and indeed from the style itself of some of the coin-types, we can see at once that we have here to do with no Græco-Campanian art, but with an Oscan-Samnite element, at present but little known. This Oscan-Samnite art we may expect to find, and we do find, characterised by a certain harsh and almost fierce directness of expression foreign to Græco-Italic art. A full account of the excavations is to appear in the next issue of the German Archæological Institute at Rome, whose publications we have recently had occasion to notice. The numismatic and topographical notes that we have here summarised appear in the dedicatory volume presented to Prof. Curtius on his seventieth birthday (Sept. 2).

NOTES.

THE whole civilised world has just escaped suffering an irreparable loss, for such would have been the destruction of the Thorwaldsen Museum and its contents, which seems to have been at one time imminent during the burning of Christiansborg Castle in the early part of this week. A building between the museum and the burning structure was judiciously blown up with dynamite, and this seems to have placed the relics of the great neo-Greek sculptor (as he may be said to have been) out of danger. The greatest spirit was evidently shown in the attempts to save the larger groups of sculpture within the castle, but one or two fine works by Rauch, who was given to verge on the colossal, proved too heavy to carry off with the immediate means available, and had to be abandoned.

THERE appears to be a clerical demonstration in process against the proposed site for the Liverpool Cathedral, to which we referred some little time back. The main complaint against the site is that it would not allow of the clergy dwelling in cathedral precincts and "under the cathedral shadow." It is quite easy to understand the feeling of a section of the clergy on this point; but the question is whether any site can be commanded which will give sufficient area for "precincts" and residences which will be otherwise so suitable, central, and architecturally effective in locality. As to the latter point, we deny that there are any serious architectural objections to the site. A very fine building may be produced there; but there is no doubt that, owing to the nature of the ground and the close neighbourhood of the surrounding public buildings, some special treatment of the plan and design would be called for to realise the highest effect possible; the building would have to pile up rather than to spread. But special conditions and special difficulties ought surely to be an additional stimulus to architectural originality.

THE list of papers to be read at the meetings of the Architectural Association during the ensuing session, which we print elsewhere, provides plenty of matter for discussion, and includes also one or two good practical subjects, such as "Farm Buildings" and "The Ventilation of Public Buildings." There is, however, we must confess, a larger amount of pure theory and less of the illustrative element, on the artistic side of architecture, than is usual in the programme of the Association. There are two papers on "Proportion," and two (the first two) which seem rather like the same subject essentially, viz., "The Modern Architect and his Art" and "The Prospects of Architecture." Perhaps some practical conclusions may be drawn from these theoretical discussions; that at least should be the object to be kept in view.

ANENT the recent Sanitary Congress we observe that no one has yet noticed the important influence which estate and house agents may have on sanitary progress. If such an agent understands the value of proper sanitation, he will always urge on a client who desires to dispose of house property to have it put into good sanitary repair, and he is almost certain, if this be done, to obtain a purchaser or tenant with much greater rapidity and frequently of a much better character. The man who cares to have his drains in good order is almost certain to keep the rest of the house in proper condition, whereas the man who is careless about the general condition of his house will probably be careless about the condition of his drains. If house agents were alive to the importance of this, a gradual but wide-spread influence would be brought to bear on house sanitation. But any agent who does not think his positive duty lies in this direction has at any rate a clear duty cast on him of a negative character, and that is not to recommend houses as being up to the mark in a sanitary point of view when they are quite the reverse. We have before us, for example, an advertisement of a country house, issued by a very high-class firm, in which it is stated that "the drainage and water supply are excellent." A very superficial inspection of the house in question showed that a cesspool was immediately beneath the front door, that it had no overflow and no ventilation, and also that the soil-pipe was unventilated. If any one had taken the house on the strength of this representation, it is clear that an action would have been maintainable by him for a false representation if he had suffered any damage in consequence of it. And undoubtedly, on the strength of this assertion by a high-class firm, there are numbers of persons who would have taken the house without more inquiry, or without a thought of altering the sanitary arrangements. If, on the other hand, the firm had at once pointed out the state of things to the owner, it would, no doubt, have been remedied as soon as possible. It would not be easy to find a more striking example of the possibility of improving sanitary arrangements through the influence of estate agents, or, on the other hand, of an unwarrantable assertion likely to throw persons off their guard.

IT appears that the Disused Burial Grounds Act, which was passed at the close of last session of Parliament at the instance of Lord Brabazon and the Metropolitan Playground, &c., Association, is found to be practically inoperative, in consequence of the numerous exceptions which it was found desirable to introduce in order to secure the passage of the Bill. The operation of the Act is limited to burial-grounds which have been closed by order of Council, and graveyards which are the property of Dissenting bodies and private persons are exempted from its provisions. It is these latter which are most in danger from the action of the speculative builder, and it is a matter for regret that no check has been imposed to prevent the absorption of these valuable open spaces.

IN the keen competition which now exists between the various steamship companies crossing the Atlantic, every endeavour is being made to render the vessels as attractive as possible. A complete alteration of the arrangement of accommodation on shipboard, and the introduction of several new features, have been made by Messrs. Allan Brothers in their twin screw steamship *Richmond Hill* (4,225 tons), which has been built for them by Messrs. Henry Murray & Co., of Dumbarton. The most noticeable feature here is the abolition of the forecastle, the crew and enginemen being accommodated in the after-part of the vessel, while the whole of the midship is occupied by the saloon cabins and officers' quarters. The saloon, measuring 30 ft. by 25 ft., is furnished and decorated in a manner quite different from that formerly in vogue, the ancient crimson velvet and heavy gold mouldings being banished. This saloon has all the appearance of a modern dining-room, furnished in the Queen Anne style. The walls are lined with walnut, with carved panels, and between the port lights a series of large hand-painted tiles, illustrative of Shakspeare's plays, are introduced. In place of a close stove an open tile fireplace, with handsome walnut chimneypiece, is introduced, and the ceiling is finely carved and moulded. The upholstery-work of the saloon and cabins is old gold-embossed plush. The cabins, to carry forty-two saloon passengers, are all fitted on the cot system, thus avoiding the unpleasant upper berth. The ladies' cabin is placed well forward, and has separate bath-rooms, lavatories, &c., connected with it.

THE Metropolitan District Railway Company have just announced that they have diminished the number of the trains to Windsor to five in the day, as the traffic has not been remunerative. It is equally notorious that the branch of the Metropolitan Railway to Harrow, which will soon be extended to Pinner, is a loss to the general undertaking. It is quite certain that when the Metropolitan Railways

get beyond a certain short distance from their central traffic, for the present, and for a long time to come, they cannot successfully compete with companies like the London and North-Western and the Great Western railways. Persons who wish to go to or from Windsor wish to go with as little delay as possible, and no man will voluntarily travel by a line which stops at every station between Earl's Court and Windsor. Persons who travel between termini at any appreciable distance will go in the system of that company whose trains travel with the most expedition. A passenger from Harrow to Euston can by many of the North-Western trains run into Euston with only a single stoppage, at Willesden, whereas between Baker-street and Harrow there are six stations. The trunk lines to which we have alluded, having four lines of rails, can always run fast and slow trains contemporaneously, but the metropolitan companies can scarcely accommodate fast and slow traffic, or serve terminal and intermediate stations to the satisfaction of all travellers. It appears, therefore, that the experiment tried by the District Railway of running to Windsor was in any case destined to certain failure, and that the like fate awaits similar undertakings.

WE have noticed what is probably one of the earliest references to the use of indiarubber for the removal of pencil-marks from paper in a note to the introduction of a treatise on perspective by Dr. Priestley, published in 1770. The author remarks, at the conclusion of the preface, "Since this work was printed off, I have seen a substance excellently adapted to the purpose of wiping from paper the marks of a black-lead pencil. It must, therefore, be of singular use to those who practise drawing. It is sold by Mr. Nairne, mathematical instrument-maker, opposite the Royal Exchange. He sells a cubical piece of about half an inch for 3s.; and he says it will last several years."

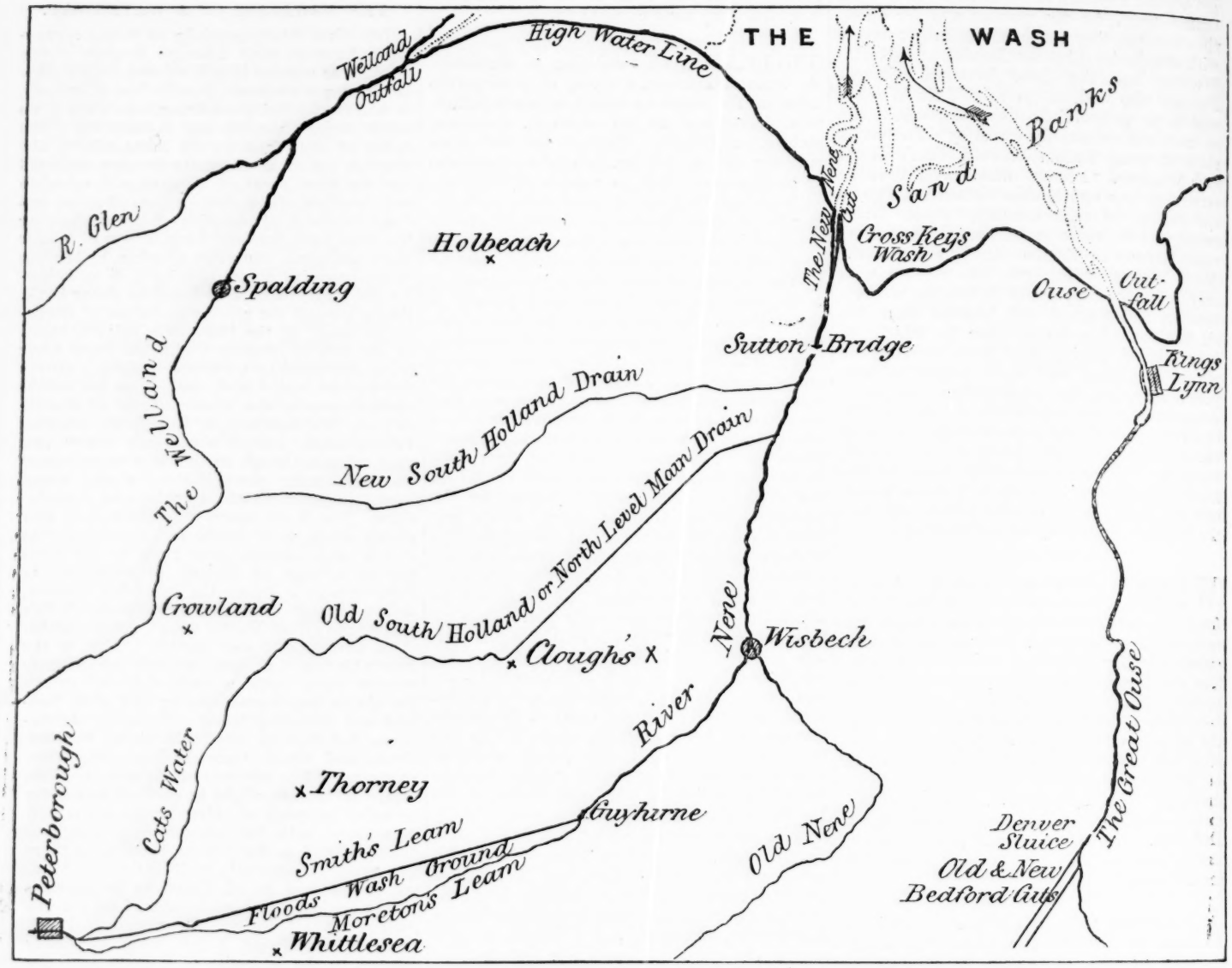
A PASSING visit to Coventry suggests a note in regard to a place the architectural interest of which is known to many, though not to so many as one could wish. There may be two opinions upon the beauty of St. Michael's Church, which, though a wonderful example of Perpendicular style, and somewhat impressive by its vastness, is so full of windows as to suggest the idea of an ecclesiastical conservatory. There is a monument in it to a "glazier," and we can readily believe that he may have expressed a wish to be buried within a fabric where so much of his time was probably spent, and that not unprofitably. Holy Trinity Church, which stands so close to St. Michael's that by telephonic agency one service and one sermon might do for both congregations, is, to our mind, a more pleasing edifice than its bigger neighbour, and, since its restoration by Sir Gilbert Scott, a more practically convenient church. Its pulpit, which projects from one of the piers which support the central lantern tower, is coeval with the pier itself, and, besides being a very striking feature, has the advantage of being so placed that a preacher with a fairly good voice is audible from it even in the choir and side-chapels. The lectern, too, is a fine piece of pre-Reformation work, and, if the eagle be not particularly aquiline in all respects, the metal is unusually subdued and pleasing in colour. In neither church has the zeal for restoration passed beyond its legitimate bounds, and, though the stained glass is chiefly modern, we cannot yet afford to condemn without measure the taste and execution of even twenty years ago. One unhappy and unique bit of modern barbarism in St. Michael's Church must be noticed. A new and elaborate font was erected there some ten or twenty years ago, and among the figures which stand within niches round its base is one which is supposed to represent "Infidelity." The figure holds in its hand, or clasps to its breast, a volume, on the outside of which are carved the words "Essays and Reviews." We are not aware whether the Bishop of Exeter or Professor Jowett ever preach within the walls of St. Michael's, but it is clear they have no right there.

THERE is now on exhibition at the Architectural Museum a series of photographs taken on the recent excursion of the Architectural Association by Mr. John L. Robinson, architect, of Dublin. They are the work of an amateur, and are not put forward as specimens of photography; but, as records of buildings little visited, they are of great value. Photographs of show houses are generally to be obtained in the next town, but there are many small subjects which, though entirely neglected by the ordinary photographer as not appealing to his customers, are of considerable interest to the architect. The advantage, therefore, of this series, taken by an architect, and including many buildings not visible to the general public, is obvious. They show at a glance the main characteristics of Suffolk work,—its flint panelling, its brickwork, its considerable lack of wrought stone, as well as its fine church roofs. There are 112 views altogether, and they embrace subjects from every place visited on the excursion. The series is headed by the beautiful Abbey Gate at Bury, which was built to overawe the turbulent townsfolk. The Abbot's Bridge follows; and those who are concerned may find in these photographs some help towards determining the exact use to which that structure was really put. Then we have the great gateway where Abbot Sampson was received on his first entry as abbot; the solemn roof over the nave at Mildenhall; the fine porch at Woolpit, handsome in design, but coarse in detail; a great many of Lavenham Church and Long Melford, among which not the least interesting is the purely technical view of the base of the church outside, showing the bold panelling, in which the mullet of the De Veres plays so important a part. There are also the wonderful Spring pew in the same church, and some excellent views of the south porch and south side. Hengrave Hall, one of the first unfortified houses built in England, and the red brick and picturesque mansions of Rushbrooke, Kentwell, and Coldham are also among the series. Thanks are due to Mr. Robinson for the care and trouble he has bestowed upon this very interesting work.

IT is curious, in fact, to observe, as we may at the Photographic Society's Exhibition now open at the Water-Colour Society's rooms, how completely "your photographer" neglects architecture as a rule. Of the nearly 600 plates exhibited by the Society, not one represents an architectural subject properly so called; there are a few commonplace street views, and that is all. Yet there is no subject for which photography is more eminently suited than the reproduction of architectural detail. In the Photographic Exhibition, taken generally, there is doubtless much good technical achievement; yet how dull is the interest excited by these microscopically perfect reproductions of form and detail in nature, as compared with that aroused by the imperfect works usually exhibited in the same room. In the one case we place between us and nature a chemical machine; in the other case, a sensitive human mind and hands. In a certain way the balance is in favour of the human agency, even in regard to verisimilitude. The instantaneous photographs of breaking waves and sea-spray, for instance, do not, somehow, look like sea. A painter would convey the idea of motion; modern photography, by its very perfection of instantaneous imprint, loses the motion, and gives us a rigid mass thrust permanently up into the air. The effect is curiously seen in a photograph of an express train, taken in the 300th part of a second. The train appears to be standing still. A photograph of lightning, which is shown, still retains the idea of motion: lightning is too quick even for the photographer. The scientific value of photography is finely shown in some photographs of magnified objects, sections of parts of plants and insects; but in regard to the representation of natural scenery the failures of the painter are worth more than the successes of the photographer, even apart from the question of colour.

THE VAGARIES OF A WATERWAY.

THE River Nene, though by no means occupying a foremost rank amongst English rivers, whether as regards length, volume, or navigable facilities, yet possesses peculiarities of history, as well as of existing condition, which are in no small degree notable and interesting. The valley of the Nene in old times offered the shortest cut of all from the eastern seaboard into the very heart of England, and colonists and invaders from the earliest Roman era down to the final irruption of the conquering Normans made free and frequent use of it over many turbulent centuries, whether by boating on the bosom of the stream itself, or by following the bridle-paths to be found on either bank. Rising towards the south-west corner of Northamptonshire, in the immediate neighbourhood of the field of Naseby Fight, the Nene after being reinforced by a number of springs affects the eastern water-shed, passing in its north-easterly course the county town of Northampton, Wellingborough, Thrapston, Oundle, Peterborough, and Wisbech, the lower and more notable, though much the shorter part of its track, being through the fen and marsh border lands of Cambridgeshire and Lincolnshire. The Nene above Peterborough is now pretty much, as to course and windings, what it has been always, even back to the most remote notings of history or tradition; at Peterborough it enters the great fen country, and in doing so exchanges a comparatively free and joyous sylvan life for one of infinite makeshift, harassment, and trouble. This is the inevitable fate of all streams which incontinently wander upon such a vast, flat, and dreary domain as that represented by the great Bedford and bordering levels. Formerly the immense flat through which the rivers Welland, Nene, and Great Ouse had to drag their weary maze-like lower courses, ere the final refuge of the sea might be reached, was under no order to speak of; river waters made passage across with the utmost irregularity and difficulty, and as for foot or bridle path there was none. So recently as 1820 the fen country, now scored in all directions by railways and embanked drove roads, offered no feasible passage at all to Norfolk travellers bound north or north-west, these being invariably reduced to the necessity of a great southern detour, if they did not relish embarking on the open sea with a view to a landing in North Lincolnshire or the Humber. These fen expanses were in the old time essentially chaotic in their conditions, demoralising every thing with which they came in contact, and especially acting most detrimentally on the tempers and dispositions of the unhappy rivers which wandered thither. The old abbots and monks of Crowland, Peterborough, and Ely early set themselves to some mitigation of the evils of the chaos reigning within view of their several monastic battlements. What little draining there was in those days came in for execution under their direction; the water-courses were annually "waded," as it was termed, that is, the weeds were cut and removed to some limited extent, and thereby the incessant choking up of the sluggish channels in some measure avoided. Towards the close of the fifteenth century, the monks of the Isle of Ely became so exasperated at the loose and vagrant habits, and occasionally riotous and destructive conduct, of the river Nene in its lower reaches, that they set determinedly to work, and from Peterborough, in a straight line seawards, cut an artificial channel, to which the unruly stream was for a long time thereafter somewhat strictly confined. Monkish attentions of this kind were not always well requited. It was up the sprawling course of the Nene, in their Viking boats, that in 870 the Northmen were carried to the pillage of Peterborough monastery, the burning of the Saxon church, and the wholesale murder of unoffending Abbot Hedda and all his monks. Hereward the Wake, the "last of the English," at a later era, by means of his knowledge of fen navigation, and to avenge himself on the new race of French abbots and friars, steered his marauding cousins from across the North Sea right up to Peterborough Ferry, and delivered over the monkish colony on Nene bank a second time to the rude shrift of these picturesque robbers. Still, notwithstanding the occasional infliction of "unkindest cuts" of this nature, the old monks remained solicitous for the keeping open of the navigation and the



Map of the Main Drainage of the Fen Country (as now existing).

maintenance of as free a course as possible for the outflow of the dangerous flood waters. Whatever may have been their sacerdotal shortcomings, they were persistent and not unenlightened drainers at least; and it was clearly noticed, after the suppression of the monasteries and the dispersion of the monks from the great fen settlements of Peterborough, Isle of Ely, and Crowland, that the Nene and its brethren gradually reverted to former disreputable habits in all their intensity, and ultimately reduced the great level to the condition of a vast watery waste, utterly useless, even if not positively pestilential.

Anciently, the natural outfall of the waters of the Nene was situated a short distance to the east of the present artificial cut. But the Nene had all along a suicidal propensity to choke itself up at its mouth and elsewhere, by means of accumulated weeds and mud brought down in suspension, and now and again for a season its so-called natural outfall would become practically disused. This meant packed-up floods for the unlucky fen expanses inland, until such time as the pressure of necessity worked out some new outfall for the ill-regulated stream. Sometimes this would be effected at a point close to the old mouth thus rendered inoperative for a time; but oftener, so it appears, the river was sadly put to it for relief, and was made to search far and near, not only north and south, but back inland as well, before some kind of tolerable makeshift of an outlet could be hit upon at all. Oftener than once in its history, and sometimes for great consecutive periods, the Nene has been obliged to the great Ouse in the matter of a passage out to sea for its sorely wandered waters. At other times it is found holding to the left, and borrowing outfall from the Welland. Indeed, the former irregularities of these rivers of the great fen region appear to us almost past belief. The River Nene has, perhaps, been the greatest of the three sinners, but if truth be spoken it is kept fairly well in countenance by the scarcely less eccentric pranks of both the Welland and the Ouse. These rivers, also, were addicted to a periodical choking up of their mouths, and then it would come to pass that they, also, had to turn back on search, and borrow or steal that accommodation failing which the up-country rains must soon transform the great East Midland level into an immense lagoon. The Ouse at times fell out by the mouth of the Nene, thus to some extent squaring the current account so long subsisting between the two waterways. The Welland also, after having utterly choked up its own proper outfall, was periodically fain to cast about southward, and beg the necessary succour from its neighbour the Nene. It does not appear, however, that the three fen rivers at any epoch ever made exclusive use of any one outfall simultaneously, but the peculiarities named sufficiently account for the discrepancies observable on the old maps, hardly any two of which, it is often remarked, agree in precise manner of outfall. The neglect consequent upon the suppression of the monasteries had in its effects reached a climax by the close of the sixteenth century, and ultimately resulted in the Government of the day according some attention to the degraded condition of the fen country. In the year 1618 Sir Clement Edmond and Commissioner Atkyns made independent surveys, and severally reported to the Privy Council on the subject. Atkyns describes the Nene at Peterborough as "a goodly fair river, 200 ft. broad and 16 ft. or 20 ft. deep." A little below Peterborough, he says, it spread out into many branches, one stretching northward, by way of Crowland, to the Welland, but, on account of that river being partly choked at the time, not receiving any very great encouragement there. "This," he says, "for want of an outfall below Spalding, cometh in a most slow course by Thorney, thrusting in his head at every ditch, and his main body falleth to Noman's Land nigh Croyland, and there runneth back by Southeæ, along by Clows Cross Head, and so to Wisbeach, with but little better success than at Spalding." After describing the wanderings of the various branch streams to the south, chief of which he shows as finding long-deferred deliverance at King's Lynn by the Ouse mouth after most dreary pilgrimage, the Commissioner continues, —"The waters of this river [that is, the Nene] be those which at this day most annoy the body of the fenns; for now that Wisbeach outfall is by mere negligence overthrown, it is apparent that that water, which is within four miles of the outfall at Wisbeach, ought never to return nor offend the country, though now, through defect of Wisbeach river, it turneth away and takes its course where it may, and much of it passeth about fifty miles before it can recover an outlet, drowning yearly by the way many thousand acres."

The earliest mention concerning the curious habits and conditions of the river Nene and the other waterways, which, by the laws of gravitation, are in their lower courses brought upon the great flat, is to be sought for amongst monastic archives only. The State at first did not regard the subject as coming within its province; and it was not until the reign of Elizabeth that the powers of Parliament were conspicuously invoked for the better governance of the fen rivers. About the middle of the fifteenth century the Nene below Peterborough, as already mentioned, had arrived at such a pitch of bad behaviour as to arouse the monastic authorities to vigorous action. Bishop Moreton of Ely headed and directed the movement, and towards the year 1485 the works resolved upon were completed, and in satisfactory operation. This was, undoubtedly, a courageous effort of civil engineering for that age. The new cut, "Moreton's Leam," as it is called to this day, commenced at Peterborough and extended in a comparatively straight line to Wisbech. Nene waters, which previously by

means of innumerable paltry branches, meandered aimlessly and hopelessly untold distances over the larger area of the great level, were by Bishop Moreton's contrivance, sped swiftly on in one powerful stream in the direction of the desired goal, and thereby both navigation and drainage raised to a degree of order and excellence never dreamed of before. The high bank on the south side of this cut kept the fenland to the south comparatively dry, and even now when Moreton's Leam is almost disused as a watercourse through gradual choking of weeds and silting up of channel, its south bank is still regarded as the barrier which, during the times of flood water, keeps the "washes" within moderate bounds, and holds the sunk lands to the south comparatively scatheless. In the 13th of Elizabeth the condition of the fen rivers was brought under the notice of Parliament, and in that year an Act was passed with a view to scouring the Welland from Stamford to the sea for the restoration of the navigation. Six years subsequently the Commissioners of Sewers sat at Peterborough; but it was not until the year 1600 that the General Drainage Act was passed. James I. encouraged the movement and brought from Holland Cornelius Vermuyden, the great water-drainage engineer of the time. James himself became an "undertaker" for the reclamation of the fenland from the thrall of the wandered river water, as did also his son Charles I.: but it was under a national contract with the Earl of Bedford, concluded 13th of January, 1630, and afterwards known as "Lynn Law," that really serious operations were commenced. The earl, as the owner of a vast marshy acreage on the banks of the Nene, was a chief sufferer from the vagaries of that stream. His contract embraced a wider area, however; and, if under the operations of his engineer Vermuyden, he could contrive to confine the rivers Nene and Ouse within bounds, so as permanently to free from intermittent flood-water a certain large expanse of the fen region, his recompense was to be a free grant of 95,000 acres of the land so reclaimed. Huge works were entered upon. The Ouse was furnished with a capacious and quite straight cut from Earith to Denver, christened the Bedford river, while the Nene, as the chief seat of the disease, received attention in the shape of numerous relieving cuts both to north and south of its main stream. A great stone sluice was erected at a place below Wisbech, called the Horseshoe, to hold the tides out of Moreton's Leam (then the main stream of the river), and another sluice at Stanground, a mile and a half below Peterborough, to shut the waters out of the old course of the Nene, and confine them to Bishop Moreton's Cut; the latter at the same time having its banks heightened on each side, and for the time thoroughly made good from Peterborough right down to Wisbech. Yet so formidable a task was the subjugation of this watercourse to prove, that, as recorded by Wells the voluminous historian of the fens, the river subsequently made light of its elaborate straight-jacketings; the curators for a time lost faith in the ultimate result of the warfare, and all these costly works were suffered to fall into decay.

In the year 1637 the Corporation of the Fens received formal charter licence from Charles, but for a time nothing followed. The Great Level Drainage Act passed in 1649, and then the Nene was again taken in hand under the direction of Sir Cornelius Vermuyden. Its banks below Peterborough were raised to a height of 8 ft., and extended at the bottom to a width of 70 ft. Moreton's Leam, a work of great service in its day, had by this time gone the way of most of the Nene channels, having, through the inevitable propensity of the river and negligence combined, become stifled with growth of weeds and gathering of mud deposits out of all efficient usefulness, whether as a navigable course or drain conduit. A new and straighter cut was now made, first called Hill's Cut, but now known as Smith's Leam, and still upheld as the main channel of the waterway. The north bank of this new cut was made of massive construction, and it has generally proved efficacious in keeping the overflow out of the fens on that side, while the considerable space left between the new Leam and the still maintained South Bank of the old or Moreton's Leam, afforded the necessary wash area for the restricted bedding of the flood-water in times of continued rainfall along the upper course of the river. The works thus executed were excellent in conception, and from this period may be dated the first tangible approach to an appreciable taming-down of water so long destructively unruly. The upper or orderly part of the Nene above Peterborough had received no great share of attention while the lower struggle was going on, but in the time of Queen Anne an effort was made to perfect the navigation from Peterborough to Northampton, though with but small measure of success. This was renewed subsequently, and the canalised upper Nene for about half a century was made lively by a tolerably brisk traffic, though the railways have since almost entirely extinguished that.

Besides the evils of weeds' growth and silting of mud and sand, the moles, if unwatched, are apt to work havoc on such embankment works as those which restrain the Nene within limits in its course over the fens. The spread of these animals has to be kept within bounds, and accordingly the banksmen in the employment of the Fen Corporation are under obligation to wage unceasing warfare on them. The outfall below Wisbech suffered severely from these and concurrent causes, and necessitated from time to time reformatory works more or less thorough-going. Kinderley's Cut, debouching into the Crosskeys Wash, formed one of those executed last century, but it was reserved to a comparatively recent period to construct such a permanent series of outfall works as are now to be found at the mouth of this river. The Act empowering these works is dated October 27, 1829. Operations were confided to Sir Edward Banks and Mr. John Rennie, and within a year or two thereafter were brought to completion, with the result that Nene navigation and drainage were found placed upon a footing of efficiency far in excess of anything previously attained. Wisbech, in subsequent years, became a seaport of importance and promise; and although of late the progress of the place has suffered a check through the operation of various causes, it has not, as the port of Nene-mouth waters, entirely lost faith in its future. Docks on a large scale, for the accommodation of steamers and sailing vessels of size, in addition to those already made at Sutton Bridge, are deemed by many as essential for the future advancement of the place, and even by some as absolutely necessary if the port is not to be permitted to become wholly decayed; but during last session the promoters failed to convince Parliament of the desirability of works of the kind, and an ambitious, and at one time rather promising, Bill was thrown out accordingly. Whatever may be the future of Wisbech, the river which serves it, and which so long troubled sorely the whole of that region, is not likely to be held much to blame. Its works are now permanently consolidated, and while, as a main artery of the fen drainage, its functions are performed fully to satisfaction, its navigable qualities and capacities depend upon nothing more serious than the requisite care in dredging, and in watching and guarding against the formation of shoal-banks in the neighbourhood of the outer mouth.

THE SANITARY CONGRESS AT DUBLIN.

From the very practical address delivered last week at the Dublin Congress of the Sanitary Institute of Great Britain by Sir Robert Rawlinson we append some passages for which we had no space last week.* After dealing with the question of sewage disposal, Sir Robert referred to other things essential to the health of towns. He said,—

"Public baths, washhouses, disinfecting apparatus, mortuaries, abattoirs, and a scavenging department are all necessary. Public baths, washhouses, and disinfecting apparatus should be as near the population for whose uses they are intended as may be practicable. They should be plain in appearance, inexpensive, and fitted up with efficient apparatus. If 20,000*l.* has to be expended in any town, it will be wiser to construct ten separate establishments placed where they are most wanted, rather than to erect one or two imposing-looking buildings to which the poor will not go,—one reason being that they are too distant. Examples of the utter breakdown of grand and costly baths and washhouses may be given. The people for whom they were intended would not use them, and so the money they cost was wasted. Disinfecting chambers should be attached to such wash-house establishments, but isolated; that is, infected clothing should be received and washed apart. To stamp out contagious disease, burning or disinfection of infected bedding and clothing should be prompt. It will be the cheapest process to disinfect, wash, cleanse, and restore the articles to the poor owners free of cost rather than retard the process by using compulsion and demanding payment; as, in this case there will be secretiveness and opposition; in the other case, ready compliance and thankfulness. Mortuaries and ambulance conveyances are an absolute necessity in towns, and should be a part of every establishment. Public abattoirs, situate in open spaces, well drained and ventilated, are necessary. Private slaughter-houses ought not to be permitted. A fire establishment is necessary; and in towns having a population exceeding 100,000 there may be several stations having electric communication with the head establishment. The scavengers' department I consider a prime necessity. All forms of scavenging should be under the absolute control of the municipality. There should be no private scavenging. To require householders at any time to scavenge their own premises is a remnant of barbarism, as when it is so left it never has been done, nor ever will be done. Scavenging should be at short intervals, and every spadeful of refuse should be cleared from the streets daily, and taken to some depôt. Such of the refuse as will burn should be burned, and other forms of refuse should be harmlessly disposed of outside the town or city. It will be a mistake to retain any refuse which is liable, by keeping, to become offensive, in the hope of selling it to make a supposed profit, as it is not the business of a scavenger to sell refuse, but to produce cleanness. In seaport towns, if refuse cannot otherwise be disposed of, it may be sent to be sunk at sea in hopper barges. Hospitals have been much discussed in recent years, and there have been great improvements, both in their construction and management; but with improvement there has been much extravagance. The prime purpose of a hospital should be to afford temporary shelter to the poor and injured; and that hospital relief should be of practical use to the greatest numbers the buildings should be cheap in construction, and the administration economical. It must surely be gross extravagance to build grand palace-like hospitals costing from 1,000*l.* up to 2,500*l.* per bed on which to treat a sick or injured man who never earned half the amount of his bed's rental when well; to make matters worse these extravagantly costly hospitals are not always found to be wholesome. A hospital to be of the greatest use should be on a dry site, well ventilated, out in the open country. The construction should be cheap, the space large, the means for ventilation abundant. Warming by hot-water or steam may be admissible, but warming by heated air transmitted through flues never, as it is not wholesome. Open fires and open windows will be best, and in summer verandahs for patients will be of great advantage. There are new hospitals near Berlin where the beds, with the patients, are moved into the open air on fine days throughout the summer. Sheds of wood, which could be burned at ten or twelve years' interval, would give the best results, and, if saving life is the prime use of any hospital, would be most economical. In such hospitals, in surgical cases, the greatest bungler could not kill; whilst in some of the grand town hospitals the most expert surgeons cannot save. This has been said by an eminent physician. I do not attempt in this address to enter at any length into the details of the reduction of disease by sanitary works and regulations. Sir James Paget, in his recent address before his Royal Highness the Prince of Wales, at the opening of the Health Exhibition at South Kensington, gave chapter and verse, setting forth great money savings by prevention of cases of sickness and premature deaths. Such saving is undoubtable. In all ranks of life, from the royal family to the poorest household, it has been shown by Mr. Edwin Chadwick, C.B., the father of modern sanitary science, that there has within the last twenty years been on the entire population a reduction of some 20 per 1,000 in cases of sickness, and of 2 per 1,000 in deaths. In the Army and Navy the saving is from 17 in each 1,000 to at present 8½ to each 1,000. In the British army in India from 69 per 1,000 down to 20 per

* See p. 453, *ante*.

1,000, and it is hoped further reductions may be accomplished. In looking over the advances made in sanitary science, it must never be forgotten that to undertake and perfect good works is one thing, but that to maintain them good is the main thing. It must also be remembered that sewers, drains, and waterworks are only means to an end,—they are only good so long as they are sound, clean, and cared for. Again, the most complete works of sewering and water-supply may leave untouched the slums and room tenements; and these places may remain nests of contagious disease, out of which stalk the grim forms of typhoid and cholera. There are towns in England where sewers and drains have been formed and a good water-supply established, but where scavenging and single-room tenement-inspection and cleansing have been shamefully neglected. The first should be done; the latter not left undone. This question of sanitary improvement is an all-round question; it embraces the entire nation, as no rank or station is exempt from disease. Fever strikes down the highest in the land as the most lowly. A nation may be wealthy, and yet be unhealthy. Richly endowed colleges may impart learning to the select few, but in town-slums vicious habits are much more profusely engendered, leading to vice and crime. In the world there is no value but in human life, and human life has the greatest value when healthy and moral. It is the aim of the members of this Congress to induce improvement, to show statesmen and the public generally that the only safety will be in assisting to remove causes which lead to sickness, incapacity, and premature death. The strength and glory of a nation is not in standing armies and ironclad fleets, but in the health, well-being, and contentment of the people."

On the second day of the Congress,

Dr. Grimshaw, Registrar-General for Ireland, read a paper entitled "Statistical Measures of the Health of Communities," in the course of which he said,—"I am glad to say that the old sanitary, or unsanitary, maxim, 'that a dense population has a high death-rate,' is becoming less true every day, as it has been proved by the operations of artisans' dwellings companies and others who have undertaken to provide dwellings for the working classes, that with reasonable precautions very dense populations can enjoy very good health and have very low death-rates. The natural inference has been drawn that the principal zymotics, or infectious diseases (as they are popularly called), contribute largely to this high death-rate in dense populations. This influence, however, cannot be very potent, and, indeed, Liverpool is the only instance where it is well marked. It would appear that more can be done by re-arranging and redistributing the dense populations within existing areas than by making futile attempts to diminish density."

Mr. Edgar Flynn, Surgeon to St. Michael's Hospital, Kingstown, read a paper on "The Administration of the Public Health Act in Ireland with regard to the Duties of Officers of Health." He said that, having held the appointment of medical officer of health in a district comprising a wide area in England for nearly six years, and having had considerable experience of the working of the English Public Health Act, he had been particularly impressed since his return to Ireland, two years ago, with the manner in which the sanitary laws appear to be carried out in Ireland. The working of the Public Health Act in Ireland, he continued, has in a great majority of districts well-nigh become a dead letter. One of the main causes of the slow progress of sanitary reform in Ireland is that there are no local boards or combination of districts, the boards of guardians are the sanitary authorities for the Irish rural districts; and, though it cannot possibly be stated that they are, as a general rule, opposed to sanitary reform, yet they are never anxious to move in any measure of sanitary work that will cause any outlay, and are deep in their expressions of gratitude to their medical officers of health for not troubling them with verbose reports, which may involve them in a heavy, and, in their opinion, useless expenditure, for sewage, water, or other works; and so year after year the Public Health Act is systematically evaded.

In the course of the discussion which followed the reading of this paper,

Mr. H. H. Collins, District Surveyor for the Eastern Division of the City of London, spoke, and attributed the small success of the Public Health Acts to the dense ignorance and apathy of the population in regard to sanitary matters. He advocated the compulsory enforcement of the Public Health Acts.

Dr. Alfred Carpenter, Dr. Cameron, Mr. R. O'B. Furlong, and Surgeon-General de Renzy having spoken,

The Chairman (Sir R. Rawlinson) commented on the fact that in Ireland the engineering officer attached to the Local Government Board had no staff, and that it has no medical staff whatever. In these respects it differed from the English Local Government Board. All applications for sanitary works came before him as Engineering Inspector of the Local Government Board, and he assured them the extravagance of some of them was so appalling that he looked over them with heart-ache. If that kind of work were proposed in Ireland, it would amount to confiscation. In Ireland they must begin with the most economical work. He had seen waterworks erected in parts of England, by which the poorest person could have as much pure water as he wished, all the year round, at the cost of 9d. per quarter.

Dr. De Chaumont insisted upon the necessity of the medical officers of health being independent of the local bodies.

At the afternoon sitting, Dr. Grimshaw presiding,

Mr. Edward Spencer, M.A., read a paper on "The Homes of the Working Classes," in which he said:—"The greatest bar to the improvement of the homes of the working classes in Dublin is the present anomalous conduct of the valuation of property. This affects not only the provision of such dwellings, but the improvement of every class of buildings. Passing to the homes of the working classes, and selecting at random seven tenement houses in various parts of the city, and seven improved dwellings, the valuation of each being the same, viz., 9*l.*, or 63*l.* for all, I find the annual rental of the old houses to be 322*l.*, of the new 118*l.* That is to say, the proprietors of the tenemental dwellings contribute 10 per cent of their income to the rates, while the owners of the new dwellings pay 27 per cent. of their income to the rates. This inequality presses on the very class we are supposed to be benefiting, as the following facts will show. I have investigated the present and former rents paid by 427 of the tenants of the Dublin Artisans' Dwellings Company, and find the present rent to average 5s. 3d. per week, the former rent 4s. 3d. Dividing these gross rents into the two items of 'rent' and 'taxes,' and applying the proportion of taxes to rent given above, it will be seen that the 'rent' of the new dwelling is 3s. 10d., and taxes 1s. 5d.; while the 'rent' of the tenemental dwelling is 3s. 10d. and taxes 5d.; it will be, therefore, seen that the extra price which the tenant pays for the improved accommodation is made up entirely of increased taxation. If a revaluation were ordered, and the expense provided for (which can only be done by legislation), the effect would be, as far as Dublin is concerned, unequal and unjust. The valuation must be made according to unions or baronies; and the boundaries of these areas are not conterminous with those of the municipal district. The result would be that if the city were revalued the new valuation would be much out of proportion with the existing valuations of the portions of the North and South Dublin Unions that are outside the city. The number of tenement houses in Dublin is being constantly increased by the conversion of single dwellings; and diminished by natural decay, demolition, or by being closed for want of sanitary accommodation. Accommodation has been within a comparatively brief period provided, or is being provided, for 1,816 of the artisan and labouring class, and for 800 of a slightly superior class; in all, 2,616 families, representing about 16,000 persons.

In the course of the discussion which ensued,

Mr. Parke Neville, City Engineer, said that one of the greatest obstacles to improvement was the fabulous prices which were obtained by owners for their premises where new streets were to be made. This had been exemplified in the case of the new street called Tara-street, where the awards had been, he believed, excessive. He believed that some sort of summary law should be introduced to deal with the subject.

Surgeon-Major J. Wycliffe Jones, in medical charge of her Majesty's troops at Naas, then read a paper upon "The Insanitary State of Small Irish Towns." In the course of it he said,—"I will endeavour to describe a small court of dwellings very recently visited. The entrance is in a narrow lane of cabins, and this opens to the main street of the town. Picture then a horrible little courtyard, some 50 ft. by 28 ft., almost completely enclosed by small dwellings; the ash-pits, pigstyes, and backyards of the front row of hovels forming the only prospect possible for those inside the court. The entire block of building does not occupy, to the best of my judgment, nearly one rood of land; nay, indeed, the one-sixth of an acre. Upon this site are built thirteen simply frightful dens; all have damp or clay floors, pools of green and black water lie all around, black typhoid mud and festering manure in abundance. Some fifty-five to sixty souls live in this court, and many pigs are kept. I measured several of the houses, and append a few results. No. 1 house, 5·7 by 14·2 by 6·9 = cubic feet less than 588; four souls live here. No. 2, 15·7 by 12 by 9·6 = cubic feet less than 1,800; five souls resident. No. 3, 15·7 by 10·8 by 9·6 = cubic feet less than 1,500, and eight souls resident. In the first about 100 cubic feet of foul damp air could be enjoyed, in the second about 300, if no lodgers came for the night; in the third about 142. For the worst description of dwelling 1s. to 1s. 6d. per week is paid, but 2s. 6d., 2s. 8d., and 3s. is very commonly demanded even for cabins, which can, with truth, be described as "unfit for human habitation." A very wide field of observation, both in Europe and in India, has not furnished me with any parallel to all this.

Sir R. Rawlinson said that he had come across in the course of his inspection parallel cases in Great Britain to those which were mentioned in this paper. The condition of affairs in England and Scotland, he was sorry to say, was not very different to that of Ireland.

On the third day, the Congress divided itself into two sections, the proceedings in both being carried on simultaneously. The more popularly interesting was that of "Sanitary Science and Preventive Medicine." The principal paper, and the one which gave rise to the most interesting discussion, was that of Mr. Robert O'Brien Furlong on "The Objects and Work of Ladies' Sanitary Associations." Mr. H. H. Collins, of London, expressed surprise that the health of the people of Dublin was so good, considering the "miserable lairs" in which the people were housed. Dr. Cameron contrasted house accommodation in Dublin with that in London, very much to the disadvantage of Dublin. Mr. J. Byrne Power read a paper on the health of Kingstown.

In the second section, Mr. Cotton, C.E., read a paper on the operation of the Public Health (Ireland) Act. He favoured the shorter term of forty years rather than that of fifty years for the repayment of loans, and said that although many of the works executed by means of the loans granted in the period of distress in 1880 and 1881 presented a minimum of utility, yet on the whole they had effected a vast amount of good.

A banquet was held at the Shelbourne Hotel in the evening. Sir Robert Rawlinson presided, and the Lord Lieutenant, in responding to the toast of his health, delivered an interesting speech, and one thoroughly germane to the occasion.

The work of the Congress was brought to a close on the 3rd inst., when

Dr. Charles A. Cameron read a paper dealing in great detail with the "Water Supplies to Irish Towns."

Professor Hull, F.R.S., followed with a paper on the "Supply of Pure Water to Country Residences," in which he stated outbreaks of typhoid and other zymotic fevers in villages and country houses might be traced to an impure water supply. Where cholera was prevalent, contaminated water was the prime cause of attack. It was to be regretted that Ireland was not so favourably circumstanced for local water supply from deep wells as England.

Mr. G. J. Symons, F.R.S., read a paper on "The Rainfall of Ireland," in the course of which he detailed the history of the observation of rainfall in Ireland. The rainfall in Dublin was probably about 30 in. Most places within about sixty Irish miles of the south or west coast had upwards of 40 in. of rain per annum, and the central, east, and north-east of Ireland have between 30 in. and 40 in., Dublin being almost, if not absolutely, the driest place in Ireland.

The Rev. M. H. Close, A.M., read a paper on

the "Geology of the Neighbourhood of Dublin as affecting its Sanitary Conditions."

Mr. John P. Griffith, M. Inst. C.E., read a paper discussing the most advantageous position for the outfall of a main drainage system for Dublin, so as to accomplish the purification of the river Liffey by discharging the sewage beyond the limits of the harbour. Having examined the different schemes proposed, he submitted that to insure successful results the whole drainage districts surrounding Dublin Bay, including Dalkey, Kingstown, Monkstown, Blackrock, Pembroke, Rathmines, Kilmainham, Drumcondra, Clontarf, and the city of Dublin, should be dealt with by a joint main drainage Board, and that the whole of the sewage should be pumped, so as to have a constant discharge at the outfall, thereby requiring no storage, and that the outfall should be at Drumlech Point, Howth. He contended that the proposed outfall at the North Bull would necessitate larger storage accommodation and costly appliances for removing all solid matter from the sewage, inasmuch as neap tides would bring large quantities of the sewage on to Clontarf strand, and also injure the harbour bar.

A long discussion followed.

Sir Robert Rawlinson remarked that Mr. Griffith, though most competent to deal with this question, was a representative of the Port and Docks Board, and might accordingly take a view quite different from persons examining the question solely from the public point of view.

Mr. Parke Neville, City Engineer, argued in support of his own scheme for bringing the discharge to the end of the North Bull-wall. Ample experiments had shown that the set of the tides would carry the discharged sewage away from the bar without leaving any deposit either on Clontarf strand or on the bar.

Professor De Chaumont, a member of the Commission for inquiring into the Condition of the Thames, unhesitatingly declared that the discharge of crude sewage into a river should not be permitted under any circumstances.

Replying to Mr. Cotton,

Mr. Griffith said he understood the cost of the Drumleck scheme over the North Bull scheme, if no reservoirs were used in connexion with the latter, would be about 50,000*l*.

The four succeeding papers related to kindred subjects,—(1) "On House-drainage in connexion with Town Sewers," by Mr. J. B. Nicholls, C.E. In all cases the work of connecting should, he urged, be under the control and supervision of a thoroughly-qualified person paid by the local authority. The Local Government Board would do well to insist that the house-drainage and connexions should be made to form part of the whole scheme of sewerage. (2) "On Domestic Drainage in Dublin," by Mr. W. Kaye Parry, Engineer to the Dublin Sanitary Association." (3) "Practical Sanitary Lessons derived from Inspections," by Mr. William Maguire, who said that house-drainage in Dublin generally was extremely defective. Out of more than 1,000 dwelling-houses inspected, from noblemen's mansions to six-roomed cottages, only twenty could be truthfully certified free from danger to the health of the residents. (4) "On Defects in House Sanitation in and around Dublin," by Mr. P. F. Comber.

A long discussion followed, in the course of which Mr. Parke Neville, City Engineer, said he thought the dangers in Dublin had been much exaggerated. When he became engineer to the Corporation the drains were almost entirely the old-fashioned square pattern, and when he proposed the use of 6-inch pipes the people almost rose in rebellion, and 9-inch were employed as a compromise. It was impossible for him to oversee the laying of all the drains, and to prevent workmen scamping their work.

In the evening Dr. Alfred Carpenter delivered a lecture on "Education by Proverb in Sanitary Work."

On Saturday last excursions were made to the Vartry Waterworks and to the Railway Works at Inchicore.

It has been decided to hold next year's Congress of the Institute at Leicester.

The Nineteenth Century Art Society.—Monday next, October 13th, has been appointed for the receiving day for the works of art intended for the Autumn Exhibition of the "Nineteenth Century Art Society," at the Conduit-street galleries.

STOVES AND GRATES AT THE HEALTH EXHIBITION.

The whole of the East Arcade is given up to the exhibition of grates, stoves, kitcheners, ranges, boilers, &c., for domestic use, as well as other apparatus for heating and warming, and appliances for smoke-abatement. Many of the exhibits are shown in action, and as the warmth imparted by them to the corridor is more agreeable at the present time than it was a few weeks ago, visitors are more likely to spend a little time in their examination. We have been unable to find many novelties in this section of the exhibition, most of the best exhibits having been shown either at the Smoke Abatement Exhibition, or in one or more of the Building Exhibitions.

Commencing at the south end of the Arcade, near the main entrance, we notice that Messrs. Barnard, Bishop, & Barnard, of Norwich, have a very attractive display of their specialities in slow combustion and other stoves and grates, set off with all the advantages that costly and elaborate mantelpieces and over-mantels, with tiled hearths and splays, can give them. The central feature of the stand is a carved mantelpiece in wainscot oak with bevelled mirrors; this, with the fire-basket, and-irons, &c., has been designed by Mr. J. B. Pearce, architect, of Norwich, for Mr. Samuel Hoare, of Cromer.

Stand 577 is occupied by the Coalbrookdale Company, who exhibit cast-iron grates, overmantels, and other of their specialities, including the "Kyrle" grate for burning anthracite coal; a patent under-fed grate, the "Holland," for burning, smokelessly, bituminous coal; a patent grate by Dr. Moore, combining both the foregoing advantages; and the "Escoutille" grate, with hoppers or scuttles for coals on either side of the fire. Another grate well worth notice shown at this stand is Dr. Pridgin Teale's "Economic" grate, of which we have heard good accounts from more than one source. Some additional fireplaces are shown by these exhibitors in Class XX., in Mr. Taylor Smith's suite of apartments in the south enclosure (entrance from Main Gallery, Queen's Gate), and the patent grates referred to are duplicated in action in a building in the grounds contiguous to the Water Companies' Pavilion. The Company also exhibit their patent kitchen ranges and Smith's "Unique" range, and a circular-fronted kitchener. Altogether this Company fully maintains its position.

Stand 578 is occupied by Messrs. Mappin & Webb with their "new patent smoke-consuming slow combustion grates," with the details of which we are not acquainted. They are shown with chimney-pieces and over-mantels, brass fenders and fire-iron, tile hearths, and all the usual accessories.

Messrs. Yates, Haywood, & Co., of Rotherham (Stand 579), are exhibitors of cast-iron chimney-pieces and over-mantels, fire-irons, fenders, and cooking ranges.

Messrs. Steel & Garland (Stand 581), of Holborn-viaduct and Sheffield, exhibit their "Wharncliffe" grates and slow-combustion grates, together with a variety of chimney-pieces and over-mantels,—one of satin wood and another of ebonised wood inlaid with bronze. These exhibitors also show a stove which, they claim, gives a smokeless fire in an open grate. It is on Dr. Siemens's principle, having a gilled-bottom grate, a directing-plate, and a gas-bar (behind the bottom bar). Air passes through the gilled-bottom grate, and thence is directed by the directing-plate past the gas-bar, so promoting combustion on the regenerative principle.

At Stand 582 Messrs. Herring & Son, of Chertsey, exhibit a very good kitchener, and the "Brookwood" warming and ventilating grates.

Messrs. S. Belham & Co., of Buckingham Palace-road (Stand 584), exhibit a chimney-piece with a very large over-mantel, ornamented with panels in Rust's vitreous mosaic. It would be well-suited for the end of a large room, although the fireplace itself looks too small. Whatever might be the effect on the combustion of the fire, the *tout ensemble* would, we think, be improved by the removal of the marble and mosaic spandrels and the enlargement of the fireplace-opening. Messrs. Belham's grates are on the slow-combustion principle. The same exhibitors show an ornamental terminal for chimneys.

Stand 585 is occupied by Messrs. Starkie, Gardner, & Co., who exhibit wrought-iron coal-cases, cressets, fire-irons, basket-grates, &c.

Messrs. Alexander Boyd & Sons, of New Bond-street (Stand 587), are exhibitors of fresh warm-air grates, by which cold air is admitted at the back of the grate, warmed, and passed into the room. A tiled pedestal-stove, with linen-airer, shown by the same exhibitors, appears to be a good and useful thing.

At Stand 593 Mr. William Peck Taylor shows his patent terra-cotta wind-guard for preventing down-draught in chimneys; it is far preferable to most of the zinc contrivances intended to effect the same end.

Mr. James Smith, of Liverpool, shows (Stand 594) a grate which claims to be smokeless and capable of being maintained at a cost of less than 2d. per day.

The Carron Company (Stand 595), of Upper Thames-street, make a very good display of serviceable stoves and ranges, including the "Beeton" portable kitchener or range, which is self-setting and appears to be well adapted for use in workmen's cottages and artisans' dwellings. It is made in various sizes, and should be looked at by visitors interested.

Stand 596 is occupied by Messrs. Newton, Chambers, & Co., of Sheffield and Great George-street, who exhibit their "Thorncliffe" ranges in various forms and sizes. We have on previous occasions spoken favourably of these ranges.

Messrs. Thomas Waller & Co., Stand 596, exhibit a cooking-range with oven and boiler, constructed to burn either gas or coal. They also show a patent steam-chest and a grilling stove of good arrangement.

The exhibits of Messrs. W. Neilson & Co. (Stand 598), of Glasgow, are characterised by excellence of finish. Amongst them may be mentioned the "*Sine quâ non*" range.

Messrs. Rosser & Russell (Stand 599), of Hammersmith, exhibit hot-water and steam-heating apparatus for warming buildings, together with a large cooking-range, and a number of boilers for gas as well as for other fuel.

Stand 600 is occupied by Mr. J. B. Colbran, of Holborn, who exhibits Dow's patent close and open fire cooking ranges.

Mr. H. Thompson, of Canonbury (Stand 601) shows a stove which appears to possess some merit as a smoke-consumer.

Mr. Richard Crittall (Stand 602) exhibits steam-cooking apparatus for use in large establishments and public institutions.

Messrs. Dean & Son, of Oxford (Stand 603), exhibit the Oxford "heat-utiliser,"—a stove with a hollow back, apparently, from which tubes project into the room on either side.

The Wilson Engineering Company (Stand 604), of High Holborn, exhibit the Wilson cooking-ranges in various forms.

Stand 605 is occupied by Messrs. A. J. West & Co. with gas-stoves; while the next stand (606) is occupied by the General Gas Heating and Lighting Apparatus Company, who exhibit various gas-stoves for cooking and heating purposes, most of them being of Leoni's patent construction.

Col. H. Stuart Wortley (Stand 607) has an exhibit which will claim the attention of visitors. He shows a variety of small stoves suited for various purposes, economical in use, and requiring little or no attention. Among the stoves shown are the "Sick-room" stove, the "Nursery" stove, the "Working-man's" stove, and the "Greenhouse" stove.

Messrs. Doulton & Co. (Stand 608), are exhibitors of majolica and other stoves for the warming of halls and other interiors. They are clean and bright in appearance, need little attention, and are economical in use.

Messrs. T. Potter & Sons (Stand 609), of South Molton-street, exhibit, among other things, their Thermhydric grate (H. Saxon Snell's patent). This stove has been used in several large public institutions, and with much satisfaction. We have on previous occasions spoken with approval of it, and its merits were acknowledged in the report of the judges of the Smoke Abatement Exhibition.

Messrs. Clements, Jeakes, & Co. (Stand 611), of Great Russell-street, have on view a large roasting-range in the old style, with roasting-jack in action, carrying four vertical "dangles" or revolving hangers for joints, with motions right and left for four horizontal spits upon which a whole sheep or baron of beef could be cooked. The chimney-piece and jack are

similar to those erected by the firm at Pembroke College, Cambridge, under the direction of Mr. G. Gilbert Scott.

Stand 612 is occupied by Messrs. Crabtree Bros., of Leeds, who show their patent kitcheners.

Messrs. H. Chappell & Co. (Stand 615), Fulham-road, exhibit a smokeless close-fire kitchener, burning coke with the assistance of gas, on the principle suggested by the late Sir William Siemens.

At Stand 617 Messrs. E. Siddaway & Sons, of West Bromwich, exhibit gas-heating and cooking stoves.

At Stand 618 Messrs. Whyte & Bradford, of Bo'ness, N.B., exhibit the "Hotspur" smokeless cooking range. It has a revolving fire-basket, and appears to have other points which entitle it to the attention of visitors.

We must reserve notice of the remainder of the exhibits in this Arcade for a future article.

ARCHITECTURAL ASSOCIATION.

The following is the Syllabus of Papers for the Session 1884-5 :—

1884.

Oct. 24.—Address from the President.
Nov. 7.—"The Modern Architect and his Art," by J. D. Sedding.
Nov. 21.—"The Prospects of Architecture," by G. Aitchison, B.A., A.R.A.
Dec. 5.—"Some Features of Japanese Architecture and Ornament," by Dr. Dresser, Ph.D., F.L.S.
Dec. 19.—"The Ante-chamber To-day and Yesterday in French and English Plans," by W. H. White.

1885.

Jan. 2.—"Proportion and Style," by L. A. Shuffrey.
Jan. 16.—"The Ventilation of Public Buildings," by F. R. Farrow.
Jan. 30.—A Discussion upon the Paper entitled "English Architecture Thirty Years' hence," read by Professor Kerr at the Conference of the R.I.B.A., 1884.
Feb. 6.—"Farm Buildings," by A. Young.
Feb. 20.—Paper (subject to be announced), by H. A. Gribble.
March 6.—Paper (subject to be announced), by J. Slater, B.A.
March 20.—"Proportion in Architecture, especially as exemplified in the Works of the Greeks," by F. C. Penrose, M.A.
April 9.—Members' *Soirée*.
April 24.—"A Prism for Architecture," by Prof. T. Roger Smith.
May 8.—"The Treatment of Angles and enclosing Lines," by J. H. Ince.

COMPETITIONS.

St. Pancras Mortuary.—Mr. H. H. Bridgman writes :—"I beg to forward you copy of a letter I have this day received from the Vestry Clerk of St. Pancras on the above matter, my object being to let competitors (some of whom have complained of the delay in deciding the competition) see that the cause of the delay appears to have been unavoidable, as, since the competition took place, a Bill has been introduced into Parliament, and become law, forbidding the interference with the burial-grounds of the metropolis, as was proposed by the Vestry, for building purposes. Another site will therefore have to be found, and I have no doubt if the complaints referred to had reached the Vestry an explanation would have been given to this effect."

[Copy.]
Vestry Hall, Pancras-road,
October 3rd, 1884.

Dear Sir,—A Committee of the Vestry have reduced the number of designs sent for erection of Mortuary and Coroner's Court to six.

Your design is one of the six, and I am directed to inform you that some delay may probably elapse before the Vestry can decide which of the plans they will adopt, inasmuch as difficulties have arisen as regards a site.

If you have no objection to this your plans will be kept until the final award has been made,—Yours faithfully,
T. Eccleston Gibb,
Vestry Clerk.

H. H. Bridgman, Esq.

Baptist Church, Newcastle-on-Tyne.—The old church in Bewick-street having been bought by the River Tyne Commissioners, a new site for more extensive buildings, to accommodate an aggregate of 1,500 persons, has been secured. Invitations were recently issued to eight architects, who have submitted plans in competition. The first premium, of 50*l.*, has been awarded to Mr. J. Cubitt, of London, who will be employed to carry out the works; the second, of 25*l.*, is awarded to Messrs. Clark & Moscrop, of Darlington; and the third, of 15*l.*, to Messrs. Thompson & Dunn, Newcastle-on-Tyne.

Illustrations.

DESIGN FOR ADMIRALTY AND WAR OFFICES.

BY MESSRS. HALL AND POWELL.

We give this week the view towards Whitehall of this design, and the two principal plans as usual. As to the general wants of the design we expressed ourselves sufficiently in our general critique on the competition at the time the drawings were exhibited. The Whitehall front is the richer and more effective of the two, and has, therefore, been selected for illustration. We append the following extracts from the architects' "report" :—

"The buildings are so disposed, and the staircases so arranged, that they can conveniently be erected in blocks at intervals.

Our aim throughout has been to preserve extreme simplicity of arrangement in the plan, and an avoidance of any irregular lines of corridors beyond what is rendered absolutely unavoidable from the nature of the site.

A leading feature in our design is thought to be the system of double corridors that is adopted almost throughout the entire building, and we believe it to be the only one in so vast a building that will enable the main arteries of communication to be properly lighted and ventilated.

It may be thought to involve a certain prodigality in space occupied by building, but it is submitted that is of small moment when compared with the result obtained, and the arrangement lends itself to a very convenient situation for such neutral purposes as waiting-rooms, interview-rooms, lavatories, and latrines, which occupy the space between the corridors that is not required for areas for light, and which are in common use by the occupants of the rooms on either side.

The upper part of all the corridors not being required to be of the height of the rooms, is made use of as a channel for heating and ventilating pipes, electric and telephonic wires, and speaking-tubes, all of which will be more fully alluded to further on.

Glazed screens and doors divide the several lengths of corridors, into sections, as necessary respectively for the subdivision of departments.

All the principal staircases have spacious well-holes, and are lighted by lantern lights from the top, thereby facilitating the ventilation of the building. The most important stairs are those on either side of the central halls in each department, affording light to them through arched openings on the several floors.

It should be observed the internal angles of the buildings are utilised for staircases, which being lighted from the top render these points, usually dark and useless, as light as other parts of the buildings.

The efficient window lighting of the several rooms or corridors is a point to which we have given much attention, and our aim has been to distribute the light equally over all, and to obtain for all rooms direct external lighting. As has been before pointed out, the corridors, waiting-rooms, interview-rooms, lavatories, and latrines are chiefly lighted by windows looking into the open courts or areas between the corridors.

The buildings would have been constructed of brick, faced with brown hard Portland stone, as being the best known material to withstand the effect of the London atmosphere, and the basement of the several fronts, and the large quadrangle carried up in grey Aberdeen granite in rusticated courses drafted at the arrises. At the bases of the principal external piers of the angle towers, &c., bronze castings are introduced, intended to contain the effigies in high relief of those distinguished in the services of the respective Departments. The areas for light and the internal corridors in the basement would be faced with white glazed bricks, in order to reflect as much light as possible. The internal corridors are proposed to be lined with coloured tiles or bricks, having a dado with border, and the space above to have a lighter colour.

Our chief aim in the preparation of this design, and in the matured reproduction that it has undergone, has been simplicity of parts and similarity and breadth of treatment in the several façades. Ornament has been kept subservient to utility, and proportion has been relied on rather than embellishments for the effect that it has been sought to produce.

A simple type of Italian architecture has been adopted as most appropriate for the situation and surroundings of the building."

Key to References on Plans.

THE WAR OFFICE.

A. Staff.
B. Surveyor-General's Department.
  B 1. Director of Artillery.
  B 2. ,, Supplies.
  B 3. ,, Contracts.
  B 4. Inspector-General of Fortifications.
C. Central (or Secretary of State's) Department.
  C 1. ,, ,, ,,
  C 2. ,, ,, ,,
  C 3. ,, ,, ,,
  C 4. ,, ,, ,,
D. Finance Department.
  D 1. Finance Department.
  D 2. Auditors.
E. Military Department.
  E 1. Military Secretary.
  E 2. Adjutant-General and Quartermaster-General.
  E 3. Intelligence Department.
  E 4. Deputy Adjutant-General R.A.
  E 5. Deputy Adjutant-General R.E.
  E 6. Army Medical Department.
  E 7. Military Education Department.
  E 8. Commissary-General's Department.
  E 9. Principal Veterinary Surgeon's Department.
F. Miscellaneous.
  F 1. Army Purchase Commission.
  F 2. Judge Advocate General.
  F 3. Pay Office. Commissariat and Transport and Ordnance Store Corps.
  F 4. Pay Office. Army Hospital Corps.
  F 5. Army Sanitary Committee.

THE ADMIRALTY.

A. Board-room Suite and Secretary's Department.
  A 1. Board-room Suite.
  A 2. Military Branch.
  A 3. Intelligence Branch.
  A 4. Naval Branch.
  A 5. Civil Branch.
  A 6. Legal Branch.
  A 7. Registry Branch.
  A 8. Record Office Branch.
  A 9. Copying Branch.
B. Hydrographer's Department.
C. Transport Department.
D. Victualling Department.
E. Controller's Department.
  E 1. Director of Naval Construction.
  E 2. Engineer-in-Chief.
  E 3. Director of Naval Ordnance.
  E 4. Store Branch.
  E 5. Dockyard, Ship, Gunnery, and Registry and Copying Branches.
F. Accountant-General's Department.
  F 1. First Division.
  F 2. Second Division.
  F 3. Third Division.
  F 4. Fourth Division.
  F 5. Fifth Division.
  F 6. Sixth Division.
  F 7. Greenwich Hospital Division.
  F 8. Auditors.
G. Director of Contracts Department.
H. Director of Medical Department.
J. Director of Works Department.
K. Naval Reserves Department.
L. Royal Marines Department.
M. Inspector of Naval Schools Department.

LYCH GATE.

The lych-gate in our illustration is designed by Mr. W. Rickwood, and was intended for presentation by Mr. George Mence Smith to the old church of Bexley, Kent, the contract of Mr. R. Avard, of Maidstone, at 170*l.*, having been accepted, and the greater portion of the work has been performed. The material employed is oak and wainscot, standing on a foundation of Kentish rag filled in with split flints. Encaustic tile paving has been employed, and brindled tile roofing. It appears that circumstances led to an abandonment of the original destination of the gateway, and it is now, we understand, to be erected at Erith.

PULPIT IN WROUGHT IRON.

This pulpit, which has been executed for St. Saviour's Church, Warwick-street, Paddington, was designed by Mr. F. B. Wade, and executed by Messrs. A. Newman & Co. It is an interesting example of a somewhat novel application of wrought-iron work. The only portion which in style does not seem quite to harmonise with the idea of wrought-iron work is the succession of brackets under the top rail of the pulpit. These are rather formal and stiff in outline. The panels seem very suitable and effective. Of the generally excellent artistic character of the work done under Mr. Newman's direction we have before spoken.

ST. LEONARD'S CHURCH, MIDDLETON.

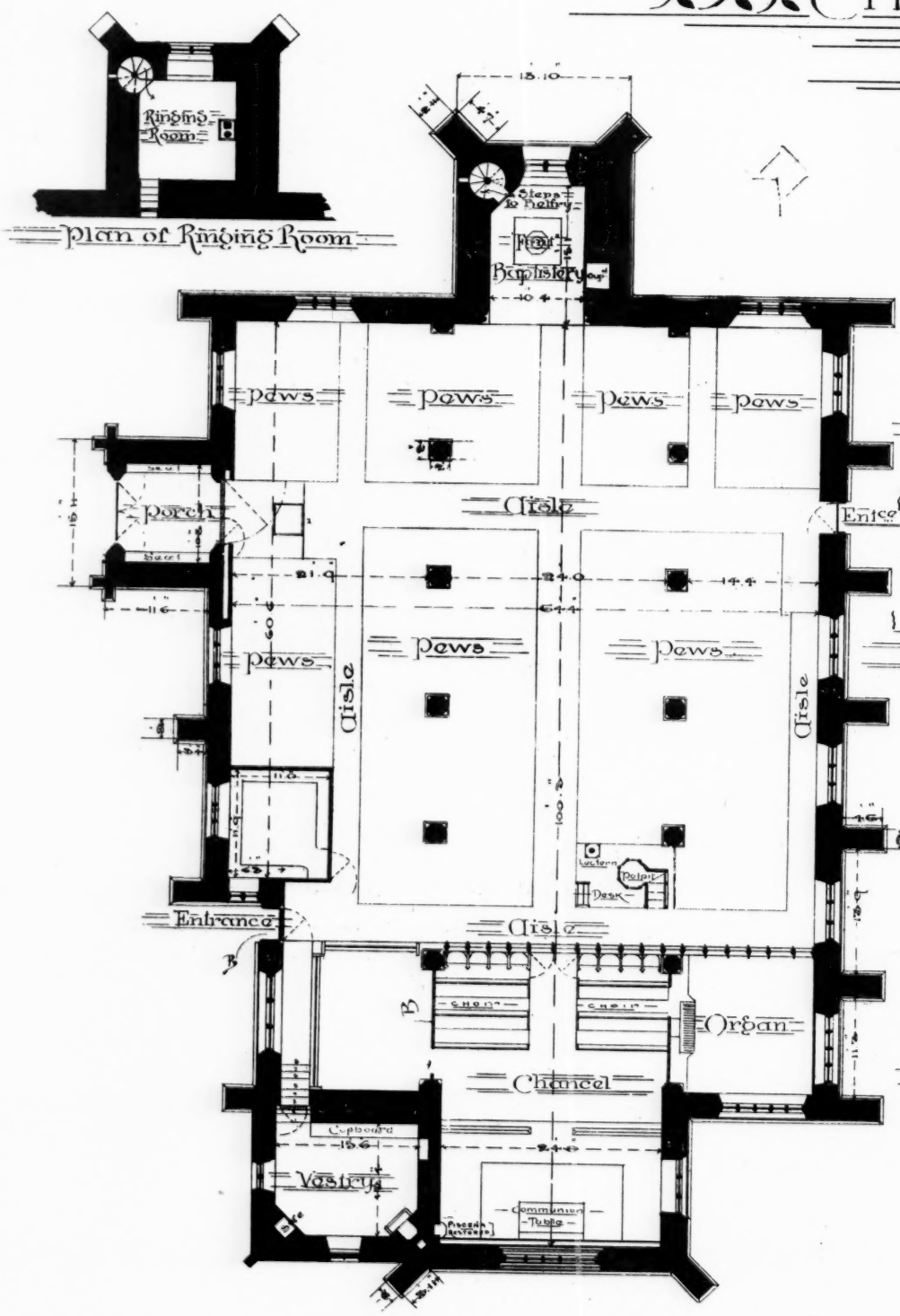
We gave last week Mr. Leeson's perspective view of this interesting little church, and we now give his plan and measured drawings of details. These include, as will be seen, some very interesting and pretty bits of detail in woodwork.

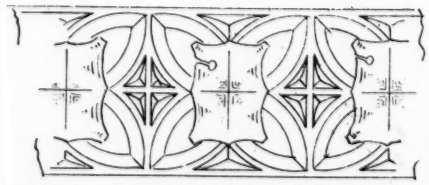
"INK-PHOTO", SPRAGUE & Co. LONDON.

NEW LYCH GATE, BEXLEY OLD CHURCH.

Mr. Wm. Rickwood, Architect.

Church of St Leon
Lancash





Wyman & Sons Photo-Litho

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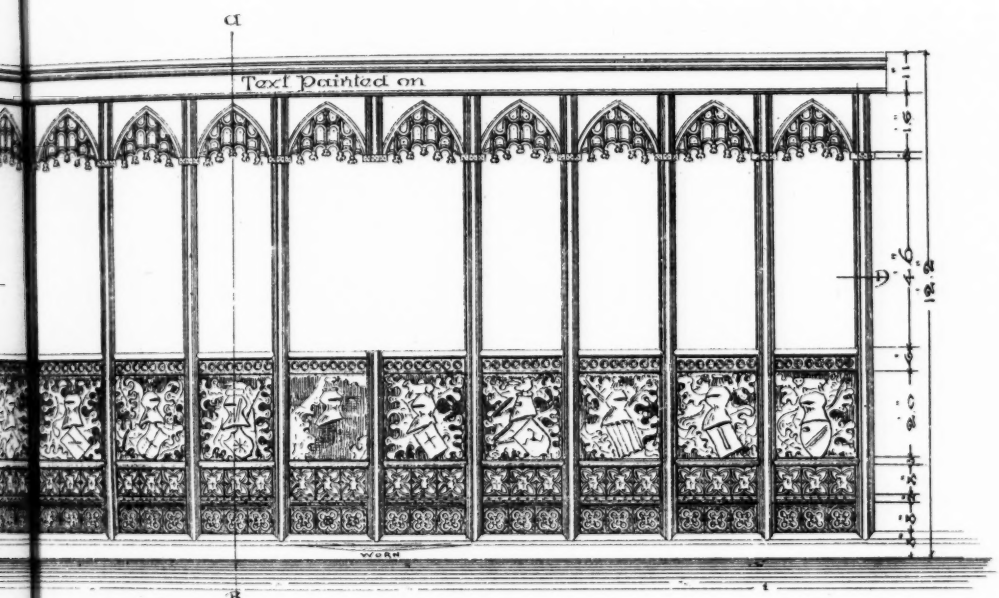
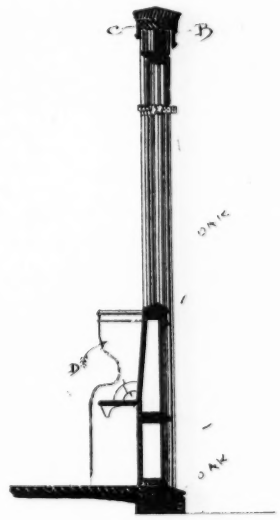
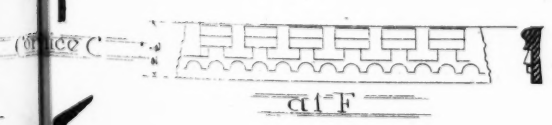


Elevation of Chancel Screen, To Church



Section AB

Plan thro C D



at F

at G

Mould on division Fronts. D

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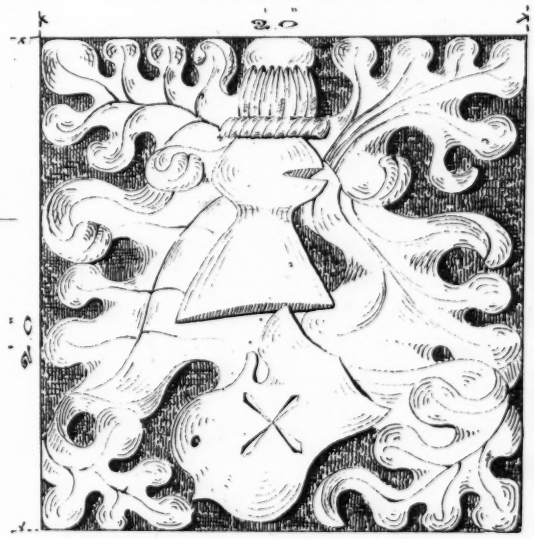
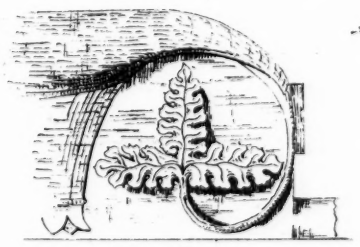


Panel, E



Seats Raised, Miserere

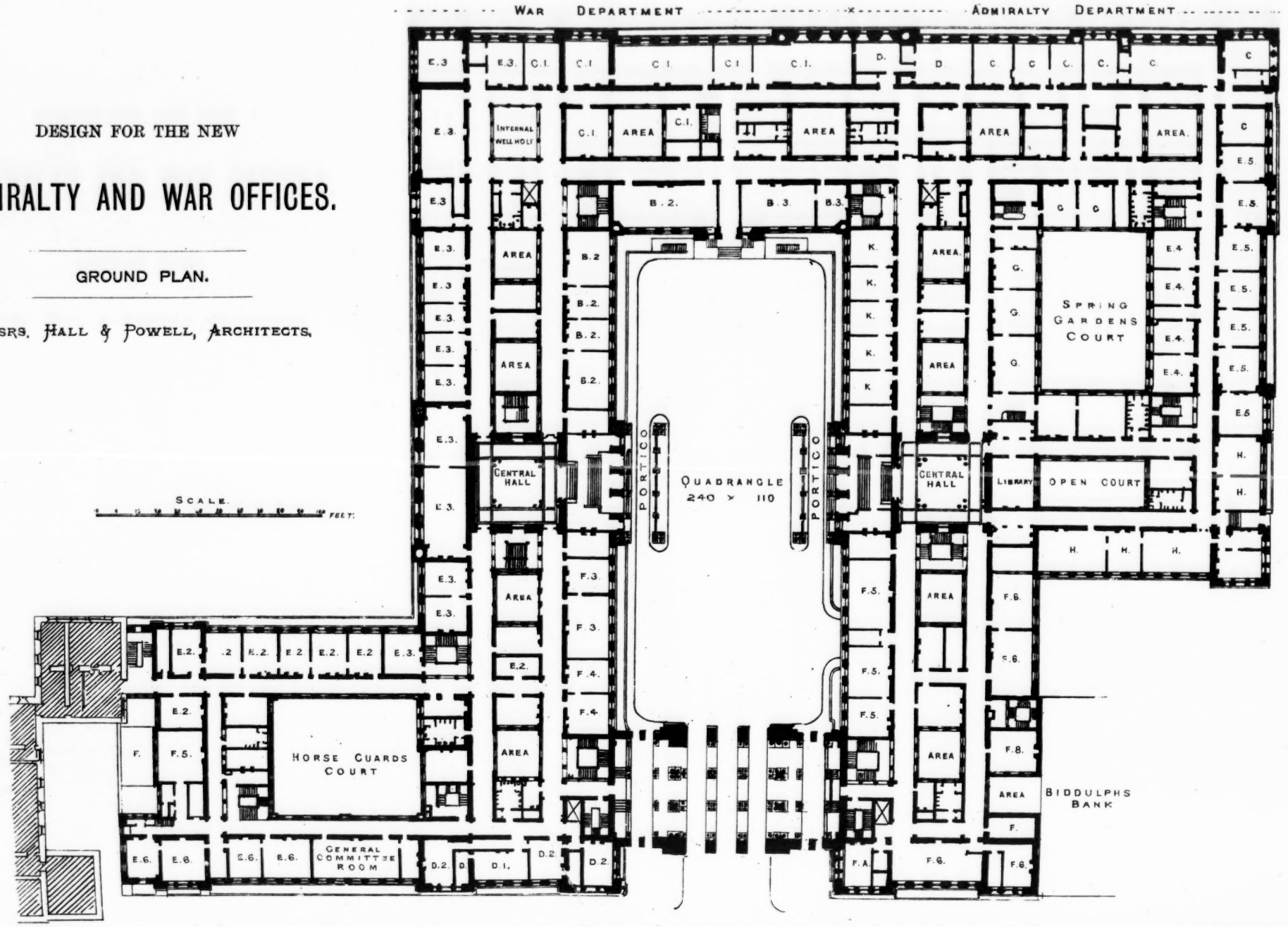
Measured and Drawn by Mr. E. W. Leeson, Oldham.

DESIGN FOR THE NEW

ADMIRALTY AND WAR OFFICES.

GROUND PLAN.

MESSRS. HALL & POWELL, ARCHITECTS.



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C^t Queen S^t London, W.C

DESIGN FOR NEW ADMIRAL

By Messrs. Hall &

Whitehall Front.

RALTY AND WAR OFFICES.

ELL & POWELL.

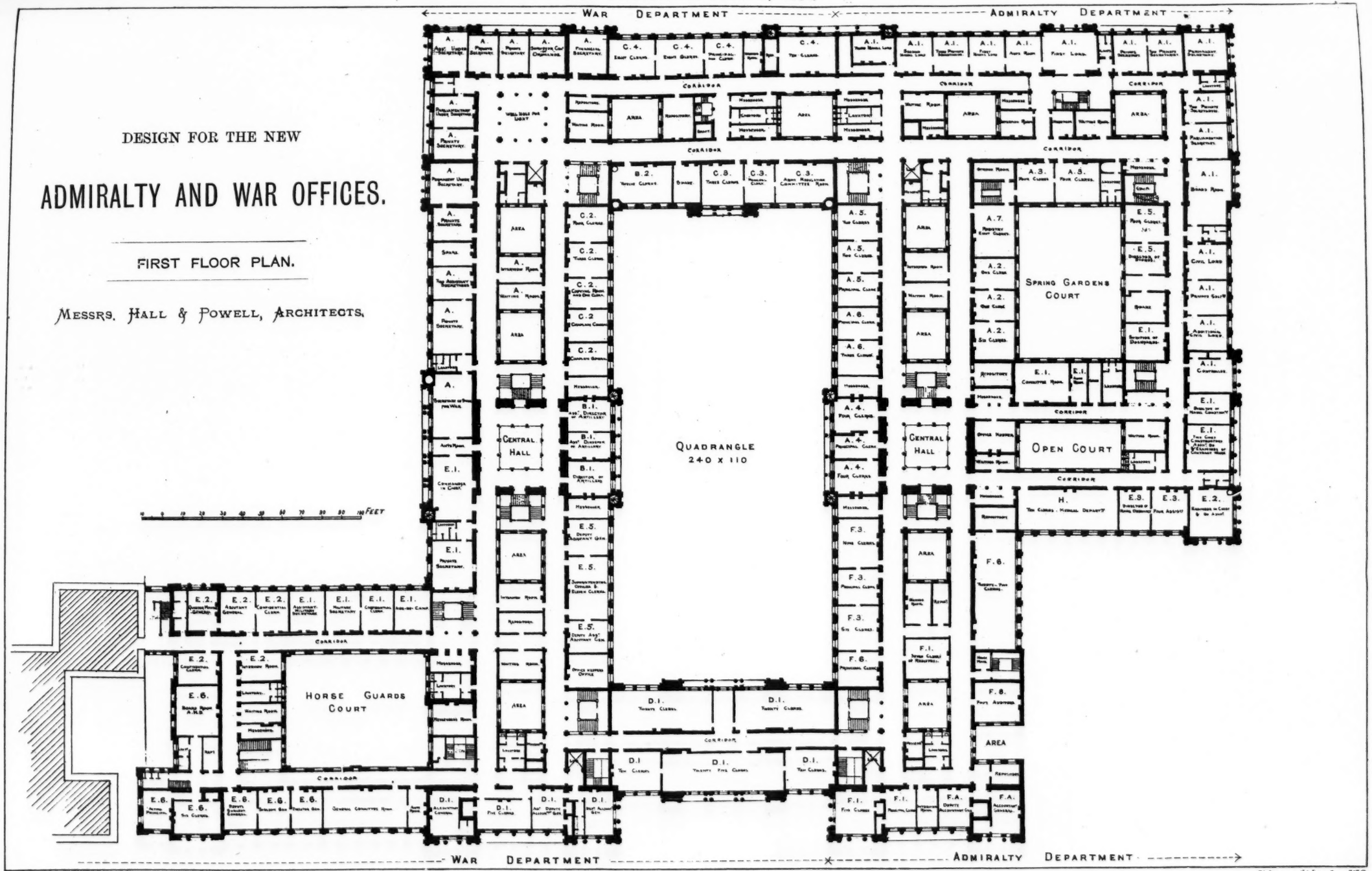
Front.

DESIGN FOR THE NEW

ADMIRALTY AND WAR OFFICES.

FIRST FLOOR PLAN.

MESSRS. HALL & POWELL, ARCHITECTS.



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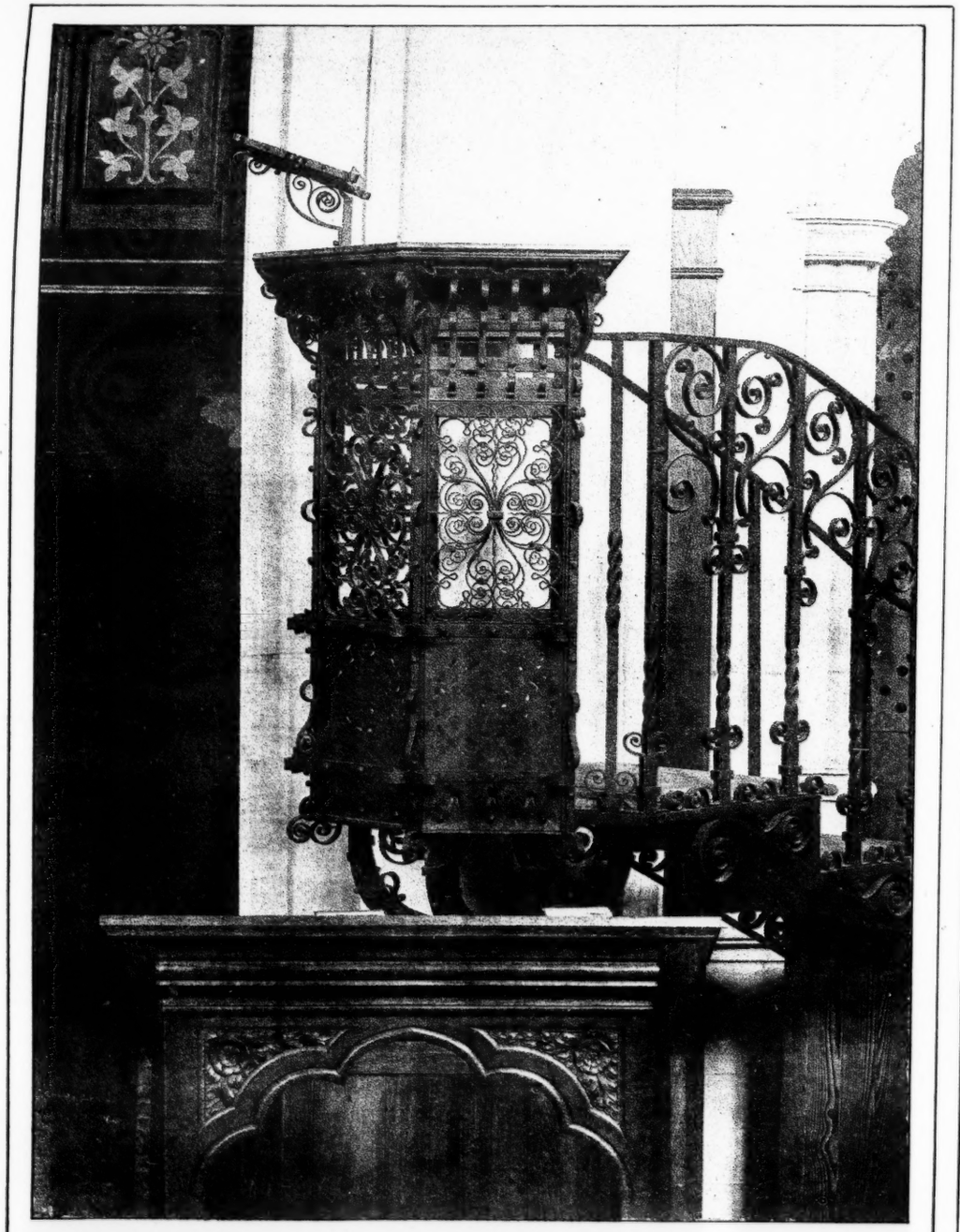

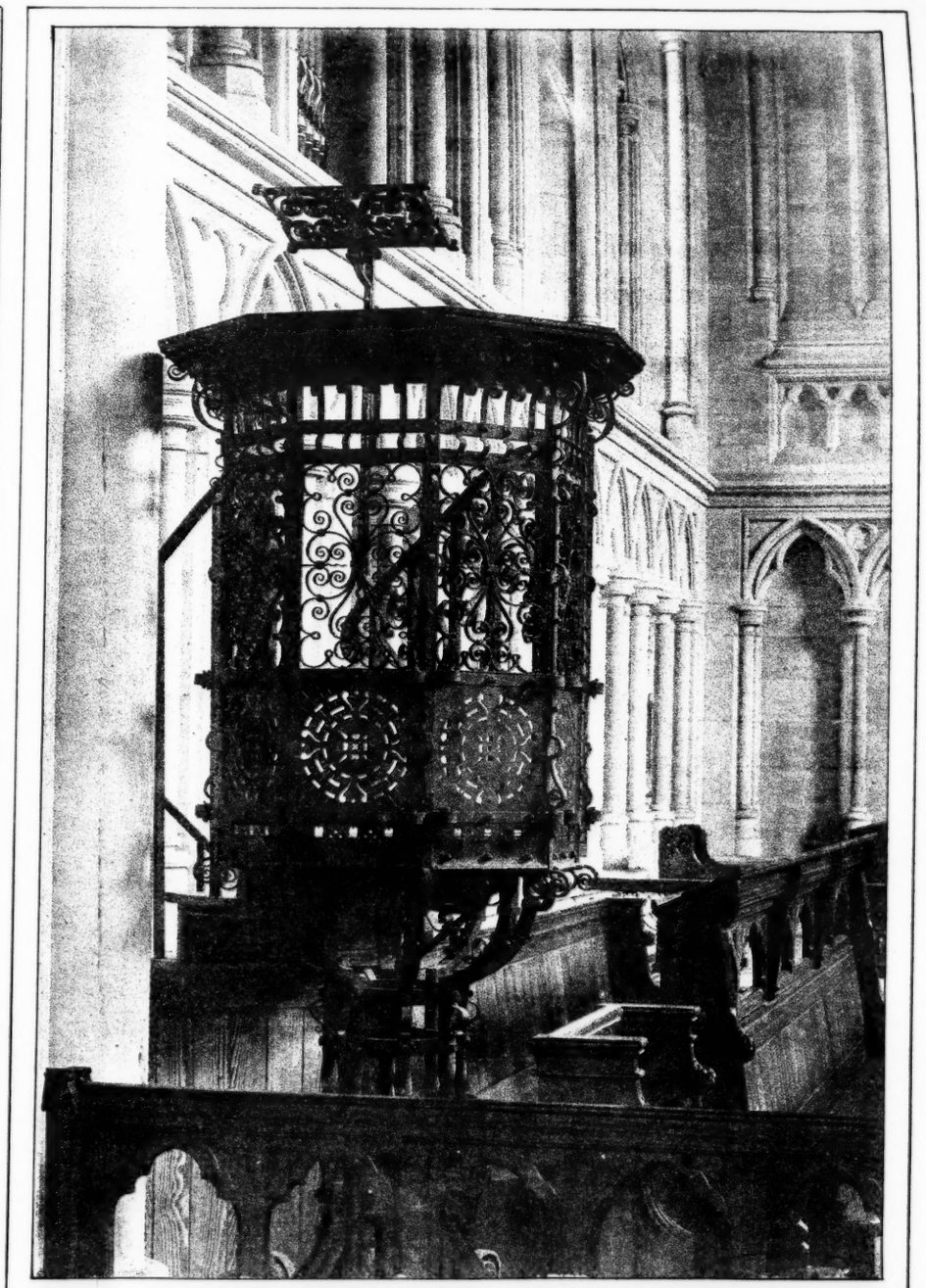

"INK-PHOTO," SPRAGUE & Co., LONDON.

PULPIT, ST. SAVIOUR'S CHURCH, PADDINGTON.

Mr. F. B. WADE, A.R.I.B.A., ARCHITECT.

THE WALL AS AN ARCHITECTURAL FEATURE.

Professor Roger Smith gave an interesting introductory lecture on this subject to the architectural students at University College, on Friday, the 3rd inst., of which the following remarks formed a portion :—

The preparation for building a wall is, as every one knows, to find or make a foundation. A bad foundation is literally, as well as in a figure of speech, at the bottom of most of the failures that occur in walls. When a good foundation is secured, the success of the wall is rendered possible. What is a good foundation? The best is one that is perfectly immovable and incompressible, such as rock. The house built upon a rock is the one safe to stand. Next to this, and only one degree less good, is the foundation which may yield or compress slightly under a load, but will do so with perfect uniformity. Soft, irregular, shifting foundations and those exposed to the action of water, frost, and air, are among the most notoriously bad ones. The ordinary London foundation is clay, in some cases mixed with loam or sand. In building on it great care is necessary; the foundation must be carried so far below the surface that frost will not penetrate to it. To secure this in the London climate you should go 4 ft. deep, and even more. The surface round the building should also be protected so as to prevent the percolation of water. The weights of the different parts of the wall should be as nearly uniform as possible, and they should not be extreme. Four tons per foot superficial is quite enough. It has become a practice of late years to form a kind of artificial rock of concrete upon the foundations of earth or clay, composed of small stones and lime or cement. This concrete, which hardens into an incompressible slab, admirably spreads and distributes the weight, and is of great use in preventing disaster. In the case of very bad foundations enormous quantities of concrete are often employed, and with success. The base of the wall, like the concrete, is below the level of the ground. It is, to some extent, a modern improvement, or, at least, it hangs on to the modern notion of building thin walls. In the Middle Ages, when walls were immensely thick, it was not very often customary to build them with spreading footings; now it is usual, and a most useful custom it is. Walls in London are required by law to be twice as wide at the bottom of the footings as they are themselves. Of all the properties a wall can possess I think stability is the most noteworthy. Of old this was sought in great thickness. The Romans first showed that constructive skill would enable men to build walls thinner than had been customary, and yet stable. Our modern walls are vastly thinner than those of the Romans; but then there are few modern buildings for which we expect, or could desire, a durability like that of ancient Roman work. Good materials, good putting together, and strong cement, with some amount of protection from weather, are what we must rely upon for the preservation of our walls. Homogeneousness, or the use of materials all of one sort, would seem at first sight to be essential to the construction of a good wall; and yet, though many ancient walls like those of Munich, and, I believe, those of Athens, were practically homogeneous, the walls cleverly put together by the Romans of three or four different sorts of materials have proved, some of them, to be all but indestructible. Uprightness is essential to stability, and to look safe a wall must be obviously upright, though a tapering form, like the pylon of an Egyptian temple, also looks strong, and really is so. Length was the ancient way of giving importance and dignity to walls; height is the comparatively modern way. In the early ages of the world, and in the ruder stages of the development of modern nations, it is extent that is relied upon where an effect is to be produced. The greatest of the temples of Egypt, for example, the temple of Ramse, with its dependencies, extended over about 2,000 ft., or more than the third of a mile. The rude stone avenues of prehistoric origin to be met with at the spot of the same name in Brittany, extend over about a mile and a third of country; and, as another example of a different kind, I may recall to you the Roman wall which stretched right across the north of England. As the power of building, and skill in the production of architectural effect increased in any nation, height was more sought after than extent; but it was, with a few exceptions, reserved for Christian and modern architecture to attempt with success buildings in which height is the main feature. Straight lines and right angles seem to have been almost the only rule in very ancient work, such as the Egyptian and the Assyrian. The Greeks first introduced curved walls in their theatres. The Romans continued and extended their use, and introduced polygonal shapes, all of which have obtained ever since. Coloured materials are to be met with at all periods of the world's history; but as their use always has reference to the architectural effect of the wall, we will postpone them to the second part of the lecture. Having now looked a little at our wall, let us try to look into it as far as we can, and perhaps an architect can look further into a stone wall than some other people, notwithstanding the old proverb. What, then, are walls made of? You may lay it down as a general rule that a wall must be made of something that lies ready to hand. In many cases the fact that the material of which some small or ornate object is to be made comes from far is a point in its favour. We prefer Italian marbles to Devonshire, or to the serpentine of Cornwall, not because they are always more beautiful (for they are not), but because they are Italian. But for wall building so much and such heavy stuff is wanted that it never does to bring it far. Accordingly, in localities where nothing else is to be had, walls are built of earth. In Devonshire, for example, cottages, barns, and the walls of gardens and orchards are commonly of earth, and they are warm, solid, and, if well taken care of, durable; but moisture must not be allowed to get into the heart of them, or they will soon crumble. Next to earth is a material not, so far as I am aware, known in England, but once in use in the East, sun-dried bricks. Vitruvius says that the walls of Babylon were built with sun-dried bricks laid in bitumen; and it is supposed that they were largely used in Assyria and Babylonia, and that some of the shapeless mounds which now mark the site of ancient structures consist of a mass of what was once sun-dried bricks. Next, of course, we should come to brick, the material only too familiar to the London eye, and the refuge of builders throughout the world and of every age who, like the London builder, were not so fortunate as to have stone within reach. In Egypt and many parts of Italy there are remains of brickwork of great antiquity, and in Lombardy, North Germany, France, Belgium, and our own country brick has been extensively used, and is in use at the present day. Bricks were not always of the sizes and shapes we are familiar with. The Romans made them flat, more like our tiles, and in many European countries they have been used considerably smaller. The size is a good deal influenced by the weight. An English brick can be held and managed by an artisan with one hand. If it were much larger or much heavier it would take two hands, or even two men, as were probably employed on the Roman bricks. The most refined kind of brick is called terra cotta. It is of the nature of brick, but bears the same kind of relation to it that marble does to stone or silver to pewter. Terra cotta is, in theory at any rate, the most appropriate ornamental substance to employ with brickwork, and though there are some practical difficulties in the way of using it, when these are overcome it is an admirable material. The best and most desirable material for wall building is, however, stone. Every sort of stone that is in the least degree deserving the name of stone has been made use of for the purpose of wall building,—from flints, which are some of them as inconvenient in shape for the mason's use as potatoes would be, up to the hardest granite, the finest and truest freestone from our many excellent limestone and sandstone quarries, or the beautiful and precious marbles of Greece and Italy. There are stone walls in Greece and in the Etruscan plain, which have come down to us from remote antiquity, made of large polygonal stones unwrought,—or but slightly wrought,—and coarsely fitted together without mortar. There are others in Egypt of the finest polished granite with joints so close and true that the edge of a sheet of paper cannot be got between the blocks; but as remarkable in its way as these specimens of consummate handicraft is the construction of the Roman walls which were often made of small stones, such as we make macadamised roads of, set in a tenacious mortar which has hardened till it is as strong as the stone itself, and steadied at intervals by the introduction of a bond-course of flat bricks or large stones. With this mode of construction, which could be carried out anywhere, the Romans built vast works, the ruins of which remain all over Europe. There is quite as much to learn about stone as about brick; in fact, a great deal more, as, for example, how to select stone, for, owing to the ease with which many sorts of stone are acted upon by the weather, there are many precautions to be taken in the selection or use of material. I will just name the three cardinal ones, which are these :—First, select for use stone from a quarry, and from a bed in that quarry which experience has shown to be durable. Secondly, let that stone lie in the building in the same way as it lay in the quarry, or, as masons would say, bedwise. Thirdly and lastly, take such precautions as will insure that no moisture gets into the inside of your wall, or into the heart of the stones that compose it. The materials I have named all of them require to be held together by some sort of cement if the wall is to be durable and weather-tight. Lime is at the bottom of all the cements in general use, and its faculty of hardening after being calcined and slaked, and, as it hardens, of adhering to the surface of the stones or bricks with which it is in contact, is invaluable. Mortar is made of quicklime and sand. Cements and hydraulic limes are compounds (natural or artificial) of lime and other substances, chiefly alumina, which enables it to set harder, and under water, and more rapidly than in its unmixed state. I need hardly point out that where the heart of a wall is of many rough stones laid with much mortar (a substance more or less impressible), while the face is formed of few well-dressed and squared stones laid with little mortar, there must be great risk of the two parts of the wall behaving differently the one from the other when weight comes upon it. This happened in much of the work of the builders during the eleventh and twelfth centuries in England,—the period of the Norman style. Professor Willis has gone so far as to say that if a Norman tower has not fallen, that circumstance throws great doubts upon its being Norman. Certainly an immense number of them have fallen, and as an example of failure, happily anticipated before there was a fall, I may remind you of Peterborough, where the core of the Norman piers carrying the great central tower has crumbled, and the piers have arched, and have been taken down within the past year. Different from the practice of building composite walls is another which I will only just mention, that of building hollow walls as a protection against damp. We have by no means exhausted the list of materials for walls if only your patience will hold out. A modern material which I will just name, but not dwell on, is concrete, excellent if well looked after, dangerous otherwise; cheap if used in large quantities, and where there are few features or irregularities, but far from cheap in small or intricate buildings; very strong, very durable, and sometimes valuable where nature yields few materials for walls of another sort. Timber has been used time out of mind for the walls of houses, and even churches and dignified buildings, in the spots where it is plentiful. There is evidence that timber buildings were in use in Assyria, Egypt, and Lycia, from the curious fact that ancient remains of stone or marble are actually cut into shapes that imitate timber; indeed, the whole system of architectural treatment in use in Greece is a kind of petrification of timber construction. The countries of Europe where timber buildings are now mostly to be met with are Sweden, Norway, Russia, and Switzerland. They are in many ways excellent. A timber wall is by no means a bad protection against weather; but it is liable to catch fire, and so is quite unfit for use in cities. Many railway stations in England, however, are built of timber, and any one of these will serve to illustrate a cheap way of building timber walls. In Sweden whole logs, halved at the angles, are used, and a wall far more solid, durable, and weather-tight can be obtained. The same method is followed in Russia,—and you may see a good specimen at the Health Exhibition in the Russian house at the back of the dairies. Timber framing filled in with plastering or with brickwork in the spaces, called usually half-timbered work, is an excellent material for walls if done with the solidity and liberal use of strong timbers that was common in England in the sixteenth and seventeenth centuries. In Lancashire and Cheshire, in Worcestershire and Gloucester, in Kent and Surrey, and in other

parts of England you may find many fair half-timbered walls, and even here and there one still lingers in London or the outskirts. We have in these later days taken to build our walls of glass, as at Sydenham, and of corrugated iron, as in many temporary rooms and churches, and each has its uses. The newest material for wall construction in England (though not, I believe, new in China and Japan) is paper. At the Health Exhibition a very serviceable little cottage walled and roofed with paper may be found. It is known as the Willesden Cottage, and I think I may say from some little experience of it that its walls are by no means the worst within which I have been sheltered in my lifetime. We will now leave the construction of walls and turn to their treatment as an important factor in architecture. A wall, as we look at it, ought to have three parts: its base, which, though below ground, ought to be represented by some description of plinth or base-moulding; its body; and its top, which may be a coping to throw off water, or may be the overhanging eaves of the roof which it carries. These, then, are infinitely varied, but they are generally all to be seen in any wall that is architecturally satisfactory to the eye. The different ways of dealing with a wall as an architectural feature may perhaps be grouped as follows:—

I. Emphasising construction.
II. Masking construction.
III. Varying the outline or plan of the wall.
IV. Enriching the surface of the wall.
V. Colour.

Of the method of emphasising construction, which is our first division, a very ancient and obvious one is to use large stones. This was a favourite plan with the Egyptians, and the Greeks, especially in archaic times. Great stones were used in the Pelasgic walls, large remains of which still exist in Greece and in the Etruscan plain in Italy. These stones were usually polygonal, very carefully fitted together, built up without mortar, and they impress the spectator very much by the appearance of savage strength which they present. Stones of very large size occur in Greece and in Egypt, and in Syria stones remarkable for their dimensions and for the way in which their outline is marked round with a broad, round mark.

Another mode of emphasising construction, which the Jews seem to have taken a pride in, is the employment of large corner stones. When a wall is built of small or loose materials, it is not easy to make the corner strong; in fact, in parts of England the towers, which would otherwise be square, are round, because there is little else but flint to build with, and with flints you cannot make a square corner. It is usual, on account of this tendency, to weakness, to fortify the corner by building it of larger stones or better than others; and the Jews seem to have attached some semi-superstitious importance to the top stone at the corner of a building,—perhaps a more really appropriate place for a famous stone than our foundation-stone, which rarely, if ever, is part of the foundation. These stones at the corners come up again in Roman work, and still more frequently in the styles derived from Roman. The famous long and short stones at the corners of Saxon buildings, the well-marked quoins of Gothic ones of all ages, and the carefully-wrought, rusticated, and raised quoins of Renaissance buildings, all go upon the principle of marking construction. In simple and homely structures, built of materials with a fine surface on good colour, any method of marking the structure of a wall is successful. In Cumberland and Westmoreland, where many varieties of stone, rich in colour, are met with, the walls of humble churches, or even cottages, are sometimes quite a sight to see and admire from their beautiful and varied tints, especially if a method of walling be adopted which allows the natural cleavage of the stone to be seen without any tooling. Another and an opposite mode of emphasising treatment, if not construction, consists in exaggerating the squaring and dressing given to stone, and bringing it to a surface of the utmost smoothness. In the later part of the Gothic period, and in much of the Renaissance architecture which followed it, the whole surface is rubbed, and no trace of the tool is left. The same completeness of workmanship was also to be met with in Greece and in Egypt, and wherever we encounter it the spectator seems to be made sensible of the immense pains and care that have been lavished by the builders upon their wall; and to a less extent the same effect is produced by the selection of materials with a fine texture of surface and a good colour, like choice bricks. A wall consists of stones and joints, and one way of marking the construction is to make the joints more conspicuous than they naturally would be. We have seen that in ancient Jewish masonry a drift or breadth of finely-tooled work surrounds the margin of the stone. In some Greek work we meet with a severe square sinking at the joint, and in Roman work with a more strongly-marked channel. In the revived Roman, which we know as Renaissance, this accentuation of the joints of stone is practised often with great frequency; and the refined mason's work, to which we have given the absurdly inappropriate name of rustication, is one of the sources of great beauty of many Italian palaces and houses. There are many other ways of emphasising construction to which I have not time specifically to allude, but may say generally that any treatment of a wall which makes its materials or its construction evident almost invariably adds a natural and, so to speak, a spontaneous grace to buildings.

THE INTERNATIONAL FORESTRY EXHIBITION, EDINBURGH.

CONCLUDING NOTICE.

It has been arranged that the Exhibition is to be closed this Saturday, October 11th, and a committee has been formed to consider what can be done with regard to the formation of a museum and school of forestry. It is gratifying to know that the undertaking has proved a success, and that the committee will have a surplus in hand; but in regard to this exhibition, as in so many similar affairs, it is found that dissatisfaction exists as to the awards of the jurors. A meeting of exhibitors has been held, when it was moved by Mr. Taylor, of Taylor Brothers, Sheffield:—

"That, seeing the glaring inconsistencies of the awards as published, we, as practical men, consider that such adjudications cannot have emanated from competent jurors, who should have been appointed under rule 11 of the regulations; or otherwise their original decision must have been altered, after being submitted to the Executive Committee. We therefore demand that the committee appointed from this meeting have access to the original reports of the jurors."

The successful operation of an art such as forestry depends upon the application of principles borrowed from a wide range of sciences, and the classification of the theoretical branch of the study must of necessity be a matter of difficulty. To exhibit the scientific basis of such an art is hardly possible except in the form of diagrams, maps, and unattractive tables of statistics. The field of study is a wide one, embracing geology, meteorology, botany, vegetable pathology, vegetable physiology (especially in regard to the cultivation of healthy trees), fungology, entomology, and zoology, so far as they bear upon tree-life and disease. It also involves the application of mechanics and chemistry to the obtaining, preservation, and manufacture of timber and other forest produce. It will be seen that there is ample scope and range for those who desire seriously to study the subject, and it will be readily understood that in the few notices we have been enabled to give of the Exhibition we could only glance shortly over the wide field of view, and may inadvertently have laid ourselves equally open to animadversion with the jurors to whom was entrusted the awarding of prizes. Although strongly tempted to do so, we have not been allured by the artistic exhibits into following a congenial subject. The furniture shown was especially attractive, ranging from the simple work of the cabinet-maker to the most elaborate productions of the carver; and we are given to understand that the number of such articles sent for exhibition would have been much greater but for the delay in issuing the prospectus caused by the difficulty of procuring a site for the Exhibition building. The application of timber to building requirements has not been shown to the extent it might have been. The various modes of roof-construction and laying flooring, the fitting up of window-sashes, doors, &c., with mouldings applied or cut on the solid, might all have been shown in an interesting and instructive manner. Mr. G. C. Douglas, of Edinburgh, has indeed done good service in this direction by exhibiting specimens of lath imported from Russia, consisting of quartered tree or billetwood, split in lath three-sixteenths of an inch thick, and ready for placing on walls and ceilings to receive plaster. The lath shown is of excellent quality and of unusual length, being 8 ft. long, and yet split so clean as to appear as if it had been planed. It is displayed in the form of a neat harbour, having a circular-headed doorway and domed roof made ready to receive a coating of plaster or cement. But the coach-builder has been in advance of the house-carpenter, and Messrs. John Hislop & Son, of Haddington and Edinburgh, show the art of vehicular construction in various stages in an admirable manner, with several appliances for ventilating the interior of carriages, keeping them water-tight, and easy as regards motion. The vehicles are constructed both of home and foreign timber, and are remarkably light and elegant, and yet strong and serviceable. We must not overlook "The Manitoba Farm," where is shown a complete farm-steading on a small scale, such as many an emigrant to this rapidly-growing colony would be delighted to have at his disposal. The department of machinery in motion deserves more attention than we have been able to bestow upon it. The largest exhibitors are Messrs. John McDonall & Sons, Johnstone, near Glasgow; and Thos. Robertson & Son, of London. Robey & Co., of Lincoln; Sagar & Co., of Halifax; and others, show admirable machines for cutting up and working wood into the forms required. This exhibition is the forerunner of one to be opened in the metropolis, which will doubtless be upon a larger scale, but which may benefit from hints derived from it.

LECTURES ON ARCHITECTURE AT THE CRYSTAL PALACE.

On Wednesday last, Mr. G. Richards Julian, A.R.I.B.A., delivered the first of his course of six lectures on "Styles of Architecture, and their Relation to the Art of Landscape Gardening," in the Lecture-room at the Crystal Palace. The lecturer, after acknowledging the courtesy of the Council of the Royal Institute of British Architects in lending him a selection from the collection of lecture diagrams in the library at Conduit-street, said that to design the simplest architectural decoration, it is necessary to be acquainted with the characteristic forms and proportions, and the details of moulding and of ornament proper to the style with which such decoration is to harmonise, and the only satisfactory mode of preparation for such a work is a study of those forms and details. The works of the great artists of the past are our inheritance, and an attempt to ignore them must arise either from presumption or from idleness. To gain the power to design well a balustrade or a summer-house, there is no more a royal road than there is to the planning of a cathedral or of a palace. On the subject of architectural styles, the lecturer pointed out that one style did not cease suddenly and a new one spring up complete and, as it were, ready-made, but that between each there was a period of transition, when the marks of one were slowly fading and the characteristics of the next becoming more prominent,—a process most probably unnoticed by those who were creating the new style, and only evident to their posterity, who are able to look back over the ages, and trace the rise and fall of different modes and forms in design and building. Having given a rapid sketch of the history of European architecture, from its rise in Greece until the present time, the lecturer proceeded to point out in detail the distinctive features of the Doric, Ionic, and Corinthian orders, the peculiarities of Greek mouldings, and the forms of Greek ornament. After describing the celebrated hanging gardens of Babylon, and quoting the account given by Pausanias of the public garden at Athens, he referred the students to the several casts and reproductions of Greek architecture and ornament to be found in the Crystal Palace.

Hull General Infirmary.—This building is about to be enlarged by the addition of two wings and the erection of an out-patients' department, and the first stones of these new buildings were laid by the Duke and Duchess of Edinburgh on the 1st inst. The architects are Messrs. H. Saxon Snell & Son, of London, and the builders of the portion now being executed are Messrs. Jackson & Son, of Hull. The cost of the whole work will, when completed, amount to 25,000*l*.

RECENT PATENTS.

2,045, Improved Apparatus for Opening and Closing all the Latches or Bolts of a Door simultaneously. John Lowley and James Harold, Battersea. 6d.

The object of this invention is to provide a secure fastening for doors, while at the same time they can be opened with ease in cases of fire or other such emergency. The latches or bolts are fixed in series, and are operated upon in opening and closing by one and the same operation, a weighted rod, *e*, carrying latches and bolts, which extends from end to end of the door. Fig. 1 is a perspective view of

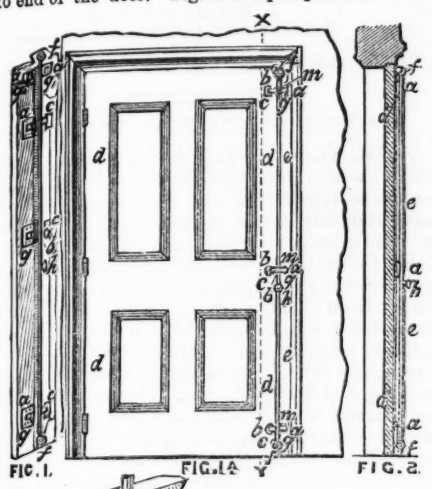

FIG. 1. FIG. 1a FIG. 2.

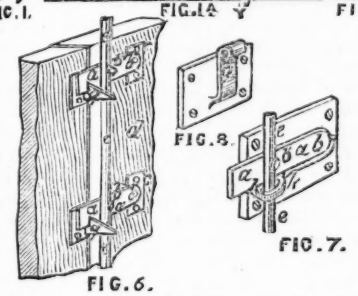

FIG. 6.

FIG. 8.

FIG. 7.

part of a door fitted with the improved latches; and fig. 2 a vertical section of the same part. Fig. 1a is a view in front elevation. The device as fitted to two doors is shown in elevations and section, figs. 3, 4, and 5. The latches shown in parallel perspective, fig. 6, are similar to those shown also in figs. 1 and 2. Figs. 7, 8, and 9 show modified forms of latches

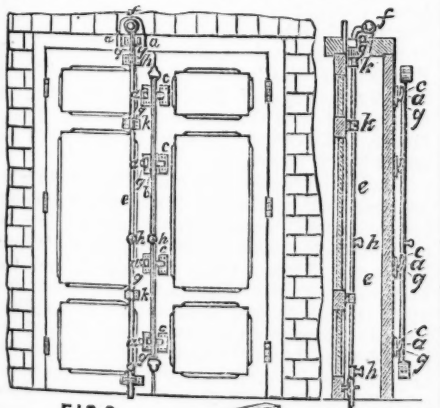

FIG. 3 FIG. 4 FIG. 5.

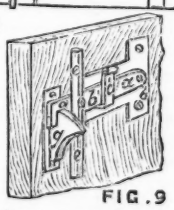

FIG. 9

with special devices in catches and loops, which may be adapted to this invention. The inventors, in describing their drawings, refer to the lettering as follows: *aa* are the latches and bolts, *ccc* are the metal plates to which the latches or bolts *a* are pivoted at *b*. These plates are attached, by screws for example, to the door *d*, and metal plates may be sunk flush with the surface of the door, or otherwise arranged. The rods marked *e* are for operating the latches or bolts *a*, and are weighted at top and bottom as indicated by the letter *f* in most of the figures. The object of weighting the rods is to give them a downward tendency, and thus to keep the latches and bolts *a* in the loops or catches *gg*, which may be made of any convenient form or shape according to the position in which they are to be placed, or as fancy or taste may dictate. The several arrangements shown in the different figures are applicable to different portions, and for single or double doors respectively. Thus, when a latch is applied to the top of a door, the kind used is such as is marked *a* in the diagrams, figs. 1 and 3. This latch, which is fixed to the rod *e* on the descent of the rod, falls into the loops, and securely fastens the door. They may be used either alone or in conjunction with other dropping latches. The arrangement, when used together as shown in fig. 1, is most suitable for single doors. For double or margin doors the arrangement shown in fig. 3 is regarded as the best. When the bolts are in position, and the door secured, to unfasten the door it is only necessary to lift the rod *e* by the knob *h* into position shown by the dotted lines *m*; this rod being connected with each of the latches, they are all raised to one time, and the door can be opened. To close the door again, and fasten it, it is only necessary to raise the weighted rod, and bringing the door to its closed position release the same, when all the latches fall into the loops. The arrangement for double doors is equally convenient, and is worked in the same way. These fastenings are particularly applicable to those doors which are required to be opened quickly in cases of emergency, while at the same time the fastenings are very secure. They are meant mainly for churches, chapels, and other public places and warehouses, and for doors to dwelling-houses. It is also suggested that they are applicable to railway-carriage doors.

7,305, Improved Fire and Water Proof Material for Roofing, Sheathing, &c. Com. by Messrs. D. A. Brown & Brigham, Boston and Worcester, U.S.A. To David Hunter Brandon, London and Paris.

This invention is for a suitable material for roofing sheathing and such like purposes, when a fire and water proof material is desired, and it consists essentially in a material composed of asbestos, moulded or formed into boards or sheets treated in succession with silicate of soda and chloride of calcium. The figures represent the material fixed to a building on sides and roof. Fig. 1 shows the building; fig. 2 is a section taken through part of the roof at *x*; fig. 3 shows another section through

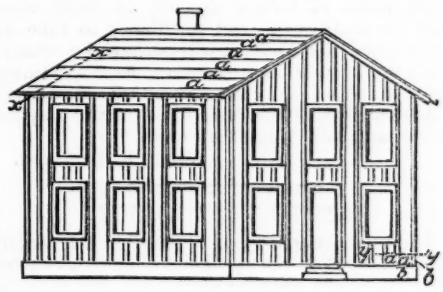

FIG. 1.

FIG. 3.

FIG. 2.

the side at *y*. In adapting the ordinary asbestos board or paper made in the usual manner to the purposes of fireproof roofing, it is treated by applying the silicate of soda with a brush, and afterwards chloride of calcium, these two liquids saturating the surface of the board or paper, and forming a surface upon it which is practically fire and water proof, the silicate of soda and the chloride of calcium preferably entering the joints in the roof or sides between contiguous pieces of asbestos board or paper. The fire and water proof material may be composed of narrow boards as at *a*, having their edges suitably overlapped, as shown at fig. 2, or the edges of the material may be abutted more closely, and be covered by a batten, *b*, as shown in fig. 3, and the parts may be nailed or screwed to the frame of the building in the usual manner, or the edges may be overlapped as usual in clap-boarding and shingling. The improved material may be shaped to resemble shingles or boards. The strength of the silicate of soda is usually reduced to about half its commercial strength, as it then better penetrates the paper and incorporates itself with the asbestos, but the chloride of calcium is used preferably of standard strength, and should be applied when the silicate of soda is partially dried.

9,246, Improvements in the Process of Etching or Engraving Marble and Granite. Frederick Walter Coons, St. Louis, U.S.A.

The stone is first faced off. It is then coated with a mixture composed of white dammar varnish two parts, and spirits of turpentine one part. When the mixture becomes so dry as not to adhere to the fingers, the whole surface to be engraved is covered with lead foil that is pressed down upon the varnish. Then draw the design on the lead, and cut out with a needle previously placed in a holder the parts of the lead-foil over the parts of the stone to be recessed. After having removed the foil where the face is to be etched, the edges of the foil are rubbed down. Then the whole face is cleaned with spirits of turpentine to remove all the varnish from the places from which the lead-foil has been removed. The turpentine is then cleaned off with fine sawdust; and next, all oil or other grease is removed with a brush and whiting. The face to be etched or engraved being horizontal, a sufficient quantity of chemically pure nitric acid is poured on to cover the whole surface and allowed to remain on a shorter or longer time according to the depth it is desired to eat into the stone. Then drain off the acid, wash with clean water, remove the foil, and clean off all the varnish with spirits of turpentine, and then dry with sawdust.

APPLICATIONS FOR LETTERS PATENT.

Sept. 26. — 12,816, J. Stephens, Stonehouse, Gloucester, Construction of Heating Apparatus.—12,818, J. Tucker, Walthamstow, Automatic Measuring and Registering Tap.—12,821, T. Robinson, Bristol, Water Meters.—12,857, D. Nicoll, London, Movable Huts, Sheds, Plant-houses, and other like Structures.

Sept. 27.—12,868, J. Linkleter and T. Linkleter, Tynemouth, Ladders.—12,872, W. H. Ratcliffe, Birmingham, Wrenches.—12,875, W. J. Stokes, London, Sash-fastener.—12,880, G. Trice, London, Lock Protector.—12,881, J. Menzies, London, Cutting and Shaping Stone.—12,886, E. B. Ellington, London, Jointing High-pressure Pipes. — 12,888, W. B. Smith, London, Bricks for Building.—12,901, J. Budd, London, Imparting to Glass the Appearance of Marble or other Stone.

Sept. 29.—12,907, E. Smith, Birmingham, Opening and Closing Windows.—12,921, A. Whincop, London, Water Waste-preventing Cistern.—12,935, A. M. Clark, London, Auger Bits. Com. by W. McDinitt and C. H. Irwin, United States.—12,936, T. Christy, London, Heating Pipes.—12,937, V. D. de Michele, London, Cement-testing Machine.—12,946, T. Palmer, London, Brickmaking and Pressing Machines.

Sept. 30. — 12,965, W. H. Vivian, Llanelly, Straight Pipe Cistern.—12,973, H. K. Bromhead, London, Kitchen Ranges and Stoves.—13,006, T. Thorley and A. J. Thorley, London, Preventing Down-draughts in Chimneys.

Oct. 1.—13,016, A. G. Browning, Llanelly, Flushing Water-closets.—13,017, F. W. Wilcox, Sunderland, Ventilating Dwellings, &c.—13,021, A. MacMillan, Glasgow, Door Springs.—13,024, W. Hassell, London, Joints for Water, Gas, and other Pipes.—13,028, B. Knight and J. Durant, London, Pulley-frames for Sliding Chandeliers. — 13,053, W. H. Lindsey, London, Girders for Fireproof Structures.

Oct. 2.—13,076, F. W. Primrose and J. Mellows, London, Supports for Workmen on Glazed Roofs of Buildings.—13,083, S. Coombs, London, Door-springs.—13,089, R. Hodges and J. Archer, London, Sash-fastenings.—13,095, W. K. Brock, Boscastle, Cornwall, Building Sanitary Houses and Bungalows.—13,098, M. Stevenson, H. T. Stevenson, and T. J. Moyns, London, Cutting Wood.—13,112, T. S. Worthington, London, Producing Imitations of Wood and Marble on Painted and other Surfaces.

PROVISIONAL SPECIFICATIONS ACCEPTED.

703, J. B. McCallum, Blackburn, Water-closets and Apparatns for Controlling the Supply of Water to Cisterns.—11,660, H. H. Lake, London, Coating or Covering Wood or other Surfaces. Com. by J. Brown, United States.—11,703, J. N. Peake, London, Fastening or Securing Tiles to Walls or other like Surfaces.—11,795, J. A. Keetch, Bristol, Driving Potters' Wheels.—11,958, G. E. Smart, London, Toolstock or Brace.—12,098, W. Sargent, London, Water Waste-preventer.—12,297, S. Chatwood, London, Construction of Strong Rooms and Safes.—12,383, J. Sewell, London, Glass Roofing.—12,575, J. S. W. Edmunds, Birmingham, Sash-fasteners.—11,919, W. H. Blackwell, Manchester, Window-sashes.—11,990, R. C. Jones and J. W. Cunningham, London, Sash-fasteners. — 12,405, H. S. Cregeen and E. J. Thomas, Bromley, Sewer and Drain Pipe.—12,438, R. H. Fraser and J. Halley, Glasgow, Wood Paving for Floors, Walls, and other Surfaces.—12,466, F. W. Hoffman, London, Sawing Machinery.—12,494, A. Gerken, London, Heating and Ventilating.—12,515, C. J. Heaton, London, Opening and Closing Windows.—12,578, J. Ashworth, Hyde, Window-sash Fasteners.—12,644, R. Adams, London, Springs for Doors.—12,653, F. M. Lyte, London, Anti-fouling Paints for Submerged Structures.—12,683, E. W. Lyne, London, Improvements in Closets.

COMPLETE SPECIFICATIONS ACCEPTED.

Open to opposition for two months.

38, W. Henman, Birmingham, Sanitary Traps.—7,739, A. Purkess, Andover, Earth-closet Apparatus.—11,745, A. D. B. Douglas, London, Improvement in Joints for the Plates of Safes and Strong-rooms.—2,427, J Davies, Clifton, Manchester, Kilns for Bricks, Tiles, &c.—7,960, W. L. Gregg, Philadelphia, U.S.A., Brick Machines.

The Society of Architects.—This society held its opening meeting in a room at Exeter Hall on Tuesday last, when the President, "Colonel" Ellison, delivered an address. Judging from the list of members which we have seen, the title of the society would seem to be rather a misnomer.

THE SCHOOL BOARD FOR LONDON.

This Board reassembled on Thursday afternoon, when the usual annual statement by the Chairman, Mr. Edward North Buxton, was read. It appears that the Board have now under their charge 367 Board Schools, accommodating 328,683 children. Of these, 289 schools, accommodating 302,674 children, are new permanent schools built by the Board. One of the passages in Mr. Buxton's address was as follows,—

"In the Works Department the planning of the schools has been to some extent affected by the general adoption of large, in preference to small, schools. This change, which was recommended for the sake of greater economy of administration, enables us, in many cases, to provide a central hall for each department. Special rooms for drawing; accommodation for the centres for cookery instruction, and for the central classes of pupil teachers, though they are only needed in a few of the schools, are supplied with the least disturbance of arrangements in schools of the largest size. The tendency towards the employment of adults in substitution for pupil teachers also requires some modification in the planning. A certain number of square class-rooms, accommodating a larger number than are entrusted to a pupil teacher, are thus a feature of our newer schools. A better concentration of the class is thus secured, and left-hand lighting for the whole room is rendered more generally possible. In other respects, minor improvements suggested by experience are adopted from time to time. At the instance of the Chairman of the Works Committee, whose connexion with measures for arresting disease in London is well known, special attention has been paid to the sanitary condition of our schools, and it may be safely said that this is now as well considered and as complete as in a first-rate hospital. At a time when dangerous epidemics threaten the metropolis, I feel that this will be satisfactory to the public mind. In some of our schools considerations of expense and contracted sites have compelled us to provide playgrounds on the roof. It is worthy of note that the winning school in the drill competition this year was confined for its practice to an airy but limited space of this kind."

THE SOUTHWARK AND VAUXHALL WATER COMPANY'S NEW WORKS AT STREATHAM.

In addition to their existing works in connexion with the supply of water from the Thames, the Southwark and Vauxhall Company are constructing new works at Streatham for obtaining a further supply from the numerous springs in that locality. They have purchased, for the purposes of the undertaking, about four acres of land on what is known as the Manor Park estate, situated between Streatham and Tooting, which is at present being laid out for building upon. On a portion of the land so acquired a deep well has for some time past been in progress of sinking. The well is 10 ft. in diameter. The first contract was taken by Mr. W. Webster, who completed it about six months ago. Since that time the company have taken the further sinking of the well into their own hands, and the works have been carried forward by the company's workmen, under the superintendence of Mr. J. W. Restler, C.E., the company's engineer. Some two or three weeks since a depth of about 260 ft. was attained, and it was intended to go down through the chalk to a further depth of 90 ft., but in consequence of the abundant and apparently inexhaustible supply of water met with it has for the present been deemed unnecessary to proceed further down through the chalk. During the last three weeks incessant pumping has been necessary in order to keep down the water. The engines have raised about 1,500,000 gallons of water every twelve hours, notwithstanding which the well registers a depth of 180 ft. of water. The engines and pumps have been constructed at the company's works, the pump being the invention of their engineer. The works include the erection of a lofty water-tower and the construction of a capacious storage reservoir.

Meanwhile, the inhabitants of Tooting and the neighbourhood are up in arms against the action of the company. There are several springs, and upwards of 120 artesian wells, in the locality, from which Tooting and Mitcham are principally supplied with water, without any necessity for having recourse to the water companies. It is alleged that within a few days after the pumping at the company's new well commenced the supply from these springs and artesian wells ceased, causing the inhabitants serious inconvenience. On Monday night a crowded meeting of the owners and occupiers of property in Tooting was held in the Vestry-hall, when it was stated that upwards of 500 houses had been deprived of water since the pumping commenced, and that several breweries and other works, which had for several years past been supplied from their wells, were now deprived of water. A committee was formed with a view of ascertaining the rights of the inhabitants on the question, and whether the Southwark and Vauxhall Company could legally deprive them of water and afterwards charge them for its supply. The matter is causing much agitation, and is not unlikely to occupy the attention of the law courts.

DECORATION OF ST. PAUL'S.

Sir,—In his rejoinder to my remarks on his first letter to your columns on the dome of St. Paul's, Mr. W. Cave Thomas concludes by asserting that "it is the duty of Englishmen, of the citizens of London, and of artists, to respect the name and works of Sir James Thornhill." How Mr. Thomas can reconcile this ultra-conservative claim on behalf of Thornhill's monochromes with his own special programme for their destruction, viz., by translating them into colour, by over-painting, and the use of gold fields, of which Thornhill never dreamed, is wholly beyond my comprehension. Thornhill, if he could speak at this juncture, would surely cry, "Save me from my friends!"

As against the proposal to efface Thornhill's work, in favour of one or other of the designs now before the dean and chapter, Mr. Thomas asks, "Did the great Italian masters lend themselves to the effacement of the puerile works of the early painters and sculptors?" The reply to this challenge is, obviously, that while it is difficult to cite an instance where a painter destroyed a predecessor's work by speciously altering its colour-effect by over-painting, it is easy enough to give instances where painters and architects destroyed outright works of former epochs, to make clear way for their own. Not needlessly to take up your space, Mr. Thomas will perhaps be content with my brevity in instancing, as a pertinent case in point, the effacement of Perugino's "Assumption of the Virgin," to make way for Michelangelo's "Last Judgment."

John R. Clayton.

SEWER VENTILATION.

Sir,—Referring to your "Note" in the *Builder* of the 27th ult. on the ventilation of sewers, I cannot understand how eminent authorities can advocate for the proper ventilation of sewers, "gratings in the road, and as many as possible,"* as the best means of effecting it. Why not open the sewers at the top with gratings all along the street? The danger would be no greater, and ventilation would be complete.

The proposed shafts, in my opinion, cannot be made to work effectually (even if they are prevented from subsidence of brickwork, or faulty workmanship, from being absolutely dangerous) without an efficient supply of fresh air; and it will be found sooner or later to be necessary to pump such into the sewers by artificial means.

The sewers will have to be more effectually flushed, especially when the fall is slight, and this applies to the majority of sewers; and the best means of effecting this is by tubes at the top laid on to a bountiful supply of water turned on when necessary, and the deposits thereby effectually disposed of.

K. C. J.

SURVEYORSHIP OF THE PARISH OF CHELSEA.

Sir,—This important and responsible post has recently been advertised as vacant in the *Builder* and other papers. The words usually added to advertisements of this class, "Canvassing either directly or indirectly will disqualify a candidate," have,—no doubt accidentally,—been omitted. May I suggest that any who may attempt to obtain an advantage over their fellow candidates by canvassing may have their testimonials returned?

Fair Play.

ZINC ROOFS.

Sir,—In your review of Mr. Fletcher's "Text-book" [p. 443, *ante*], you state correctly that it is better to specify the weight per foot super. as well as the gauge. We believe that the gauge since 1875 has been alike for all qualities.

What is meant by "No. 13 for flats and No. 12 for gutters"?

Nothing less than No. 15 (equal to the old No. 14) should be used for roofs; and gutters should be thicker, of course, say No. 16.

The Vieille Montagne Company do not stamp anything below No. 14 as suitable for roofs.

Every sheet rolled by them is stamped with their mark and the gauge.

J. & J. S. Edmeston.

* Those words were not used in our note.

"ARCHITECTS' AND CONTRACTORS' HANDBOOK."

Sir,—You were good enough some few months ago to notice the "Architects' and Contractors' Handbook," and to offer some suggestions as to classification, of which I propose to avail myself in the forthcoming issue.

May I be allowed, through your columns, to ask architects, manufacturers, and others, for particulars of any materials, inventions, and appliances not included in the last edition, as it is my desire that the book may contain as much information as possible, and be of real value for reference by architects and contractors?

J. Douglass Mathews,
Editor of the "*Architects' and Contractors' Handbook*."
11, *Dowgate-hill, London, E.C.*

CHURCH BUILDING NEWS.

Asthall (*Oxon.*).—The parish church of St. Nicholas was re-opened on the 6th inst., after complete restoration, the cost of the works to nave and aisle having been borne by Mrs. Collier in remembrance of her husband, the late Mr. John Collier (who was architect and surveyor to the Salters' Company), and that for the chancel by Eton College. New open-timbered roofs have been substituted for the flat ones, the original pitch being indicated on the gables and tower, the chancel being ceiled under the collar in octagonal form, with moulded intersecting ribs and carved bosses. The walls have been rebuilt where absolutely necessary, and the windows and stone dressings most carefully renewed where decayed, and the floors have been laid with Gregory's wood-block flooring. A memorial of stained glass has been inserted in the east window of Bateman's Chapel, and a restoration of the old north window has been well executed by Hardman. An oak screen has been fitted to the tower arch, forming an enclosure which will be used as a vestry. A new pulpit has been well carved in oak by Frith, of Gloucester, on a base of Milton and Forest of Dean stone, as also a reading-desk to correspond with the latter, being the gift of Mrs. Bateman. The Vicar has given an oak lectern and altar, with altar space. The works have been carried out by Mr. Alfred Groves, of Milton-under-Wychwood, Chipping-Norton, from the designs of the architect, Mr. Charles W. Merrin (of the firm of Messrs. Collier & Merrin), 23, Rood-lane, London, at a cost of about 1,100*l*.

Knighton-on-Teine (*Worcestershire*).—It has been thought desirable to restore the old Norman church, which is in a rapid state of decay. The seats and pulpit are to be in English oak, the latter richly carved. Messrs. Weaver & Adye, of Devizes and Bradford-on-Avon, Wilts, are the architects, and Mr. George Moore, builder, of Trowbridge, has been entrusted with the work.

London.—During the past few weeks what are described by the *City Press* as "considerable improvements" have been made in the interior of the parish church of St. Sepulchre, Holborn Viaduct. These were completed on the 12th ult. Two lobbies have been added, one upon the north and another on the south entrance doorway from the porch. They have been designed so as to accord with the ancient architecture of the tower and vestibule, as rebuilt in 1450 by Sir John Popham. They are constructed entirely of oak panelling, the upper portions being formed of richly-carved open tracery, filled with plate glass, and large and elaborately-carved cornices. The doors are made to swing both ways, so desirable in the event of a panic arising at any time, giving at once direct exit from the church. The lobbies have been erected by Mr. John Emery, of the Gray's Inn Joinery Works, Theobalds-road, W.C. The architect is Mr. Arthur Billing, of Tooley-street.

Whitwood Mere, Castleford.—The Potteries Mission Church here will consist of nave, chancel, vestry (with heating-chamber under), and porch, and is to be constructed of brick, with pressed facings, and stone dressings externally and internally, with open-timbered roof of pitch-pine, having hammer-beam principals, moulded purlins, and battlemented cornice. The roof is to be covered with boards, roof-felting, and Welsh slating. A flèche will serve the double purpose of bell-turret and foul-air extractor. The chancel arch is to be formed in three orders of brick, with moulded stopped angles, and the windows glazed with cathedral glass in leaded lights. The heating is to be performed by means of hot water. The church

will seat 250 persons. The architects are Messrs. Perkin & Bulmer, of Leeds.

Bromsgrove (*Worcestershire*).—The Bishop of Worcester has consecrated the new church for the ecclesiastical district of Finstall, which is part of the parish of Stoke Prior. The new church has been built to supersede the old church, which has become inadequate for the accommodation of the congregation, and, like the old building, is dedicated to St. Godwald. It has been erected upon an elevated site at Rigby, near Bromsgrove Railway Station, from the design of Mr. John Cotton, architect, of Bromsgrove and Birmingham, and at present consists of nave, south transept, and chancel, but is capable of extension by the addition of north transept, organ-chamber, and vestry, and a tower and steeple can also be added at some future time. The building is faced with axe-dressed local sandstone, and lined inside with buff pressed bricks tuck-pointed in red mortar. Box-ground Bath stone is used for external dressings. In style it is of the Early Decorated type. The church has an open-timbered roof covered with purple tiles. Encaustic tiles are used in sanctuary and transept. There are sittings for 214 adults and twenty-six children, and for twenty-two choristers. The cost of the building has been nearly 2,000*l.*, Messrs. Brazier & Weaver, Bromsgrove, being the builders.

Camberwell.—A new church dedicated to St. Michael and All Angels has just been erected in Camberwell, and it is to be consecrated by the Bishop of Rochester in the course of a few days. Although the church is situated in the parish of Camberwell, it is in connexion with the neighbouring church of St. John the Divine, Vassal-road, Kennington. The church and schools in connexion are situate in Toulon-street, off Wyndham-road, extending eastward to Sultan-street, in which is the principal entrance to the church, although the main elevation, and also the entrance to the schools, is in Toulon-street. The frontage of the block in this street is upwards of 100 ft. in length, and Gothic in character. It is faced with red Suffolk brick and concrete stone windows and dressings. The church, the interior dimensions of which are 66 ft. in length and 28 ft. in width, forms one unbroken oblong area, without being divided into nave and aisles as in most churches. At the west end there is an organ and choir gallery, under which is the vestry, the chancel being at the east end. The church will seat a congregation of about 400 persons. The two schools forming portions of the block, one for boys and the other for girls, are each 66 ft. in length and 22 ft. in width, containing almost as large an area as the church. The boys' school is on the ground-floor, and the girls' school above. Mr. F. W. Hunt, of Upper Baker-street, is the architect, and Mr. F. Buchan, of Camberwell, is the contractor. Mr. Hockey is clerk of the works, and Mr. Double the foreman. The cost of the buildings will be about 5,000*l.*

Leith.—St. John's Parish Church, Leith, has been re-opened, after being re-decorated and painted, the rather dismal appearance of the interior having been changed into one of lightness and cheerfulness. The end wall required to be treated as a suitable background for the pulpit, and this has been done by combining the two large windows with a band running round the outside of each, and on the inner side as far down as the spring of the arch, and there joining horizontally, leaving a square space below, the upper part of which shows a rich arrangement of borders and bands, enclosing a ribbon, with the text, "We praise Thee, O Lord our God." Below this is stencilled a tapestry pattern in the later Gothic style, in gold colour on brown, against which the new pulpit stands out in good relief. The new pulpit is by Mr. Jno. C. Hay, architect; while the decorations have been designed and executed by Messrs. Geo. Dobie & Son, 23, George-street, Edinburgh.

Whiston.—At the harvest thanksgiving at Whiston church, near Rotherham, on the 25th ult., the new font-cover which the Earl of Effingham has just presented to the church was unveiled. It has been especially designed by Mr. John Oldrid Scott, by whom the general restoration of the fabric was carried out. The new cover is spiral, and of a slight ogee outline, taking at the base the octagonal form of the bowl. The lower parts are richly moulded and embattled, whilst every cant above exhibits much tracing and carved work. The cover has been made by Mr. Harry Hems, of Exeter.

Finchley.—The committee for building the new Church of St. Paul at Finchley selected nine architects in June last to send in competitive designs by the 20th of August, Prof. Roger Smith being appointed professional assessor. He selected three designs, from among which that by Mr. John Ladds, under the motto "Faith," was finally selected, and the architect has been commissioned to proceed with the work. The church is to be faced with Kentish rag stone, with Bath stone dressings, and will seat 632 persons. The architect's estimate of the cost was 5,850*l.*, and Professor Smith reported that he considered it could be carried out for 5,500*l.* If so, it is a rather rare and all the more creditable example of an architect's competition estimate being above the actual amount required.

DISSENTING CHURCH-BUILDING NEWS.

Loughton.—A new Baptist chapel and school were opened on the 15th ult. at Loughton, Bucks. The building is in the Italian style, and is built of red brick with white brick mouldings and dressings from the Hathern Station Brick Company. It has an open-timbered roof. All the woodwork is of red deal, stained and varnished. The architect was Mr. H. H. Dyer, of Northampton, and the builder Mr. R. Hickman, of the same town.

Richmond (*Yorks.*).—A new Congregational church at Richmond was opened on the 18th ult. The cost of the new building has been about 1,522*l.* The architects are Messrs. Clark & Moscrop, of Darlington. The mason and general building work was let to Mr. W. Shaw, Richmond; joiner's work, Mr. Harwood, Manfield; plumbing, Mr. C. Fryer, Richmond; painting, Mr. Johnson Stephenson, Richmond. The buildings comprise church and chancel, recess for organ, with present accommodation for 250 persons, deacons' and ministers' vestries, school for 150 children, lobbies, and the usual out-buildings. Provision is made for an end gallery, which will give further accommodation for 80 sittings. Externally the building is of local stone in regular courses, freestone dressings being largely introduced. The roofs are covered with Westmoreland green slates. At the south-west angle there is an octagonal tower with slated spire. The buildings are Gothic in style.

The Student's Column.

ON THE CONSTRUCTION OF FLOORS.

II.

WE have hitherto considered floors from the *carpenter's* point of view, which includes only the substructure of the floor; it is the business of the *joiner* to lay upon the timbers the boards which render the floor complete for persons to walk upon; and the methods he employs we now proceed to describe. Boarded floors are made of long narrow slabs of wood, to which the terms *planks*, *deals*, or *battens*, are given according to the widths used. Thus, *planks* are boards 11 in. wide, *deals* are 9 in., and *battens* vary from 3 in. to 7 in. in width. The thickness varies from 1 in. to 3 in., those used for ordinary floors being from 1 in. to 1½ in. thick; 7 in. is the usual width of floor boards, as the wider they are the more liable they are to shrink and leave a space between the boards, and also to warp and become hollow in the middle.

The cheapest kind of floor is that which is termed a *folding-floor;* this is laid by placing together on the joists four boards of equal length, and forcing them down so as to squeeze them tightly into a certain space; four others are then laid by their side, but so as to *break joint* with the other four, and so on. A better kind of floor is that termed the *straight-joint* floor, in which the boards are of unequal length, and all *break joint* with each other, so that no two *heading-joints* come side by side. The boards are laid closely together and tightened up with a floor-cramp. The *heading-joints*, where two ends of boards meet, are splayed so as to lap one over the other, or a groove is cut in each, and a *tongue* of wood or iron inserted. Floor boards are fastened down to the joists by means of nails called *floor-brads*, which are usually driven through from the top of the boards; where, however, the thickness of the boards admits of it, it is better to drive the brads obliquely at the edge of the boards, so that no nails are seen on the surface; this is termed *edge-nailing*.

Tongued-floors, form the best kind of flooring, the boards having a groove cut in each edge, into which a *tongue* of iron or hard wood is driven, which holds the boards firmly together, and also prevents dust from passing between the edges of the boards. A cheap kind of tongued floor is made by cutting a *tenon* on one edge of each board and a *groove* on the other edge, so that one fits into the other as they are laid, and the trouble of inserting the tongues is saved.

Dowelled-floors have the boards made with holes cut in the edges into which pegs of hard wood or iron, called *dowels*, are tightly driven. The boards are held down to the joists by floor-brads as above described. This makes a very excellent floor, but the method is now but little used.

Wood-block flooring consists of short pieces or blocks of wood 1 ft. 6 in. long, 3 in. by 3 in., which are laid crosswise, or herring-bone fashion, on the joists; this is employed for school-room floors, and others where there is heavy wear and tear.

Parquetry floors and others of a superior description of wood are not laid immediately on the top of the joists, but a deal floor is first nailed to the joists, and the finishing floor laid upon it, the edges being tongued.

When there are openings in a floor, such as is required to be made round the hearth of a fireplace, it is usual to finish it with a *margin* or narrow frame of wood which is *mitred* at the angles; against this the ends of the floor-board are made to abut, and an even joint can be made.

In order to prevent sounds from passing from one floor to another, it is a good plan to lay felt or list upon the top of the joists before nailing down the floor boards.

Stone or *tiled* floors are sometimes required to be laid on timber in the upper stories of a building; these are formed with 2½ in. or 3 in. *stone flags* cut in lengths of 3 ft., and laid across from binder to binder without the intervention of joists; the width of the binders being not less than 6 in., so as to allow sufficient bed for the flags. Since the flags weigh about one-third of a cwt. to each square foot, the load on the beams is considerably more than that of a wood floor, and they must be made somewhat stronger. By floating a thin layer of cement on the top of the flags, ornamented tiles or marble flooring can be laid. If *asphalte* or *tile paving* be used for the upper stories of a building, stone flags must first be laid on the joists or binders as above described, then a thin coating of fine concrete, and the asphalte poured thereon. The thickness of asphalte for flooring is about ½ in. It is usual to sprinkle fine sand over the surface before it hardens. If tiles are to be used, a thin coat of cement is laid over the stone paving or concrete, and the tiles bedded and jointed in cement.

Having described the methods employed in practical building of arranging the timbers for carrying floors, we now proceed to consider the strains to which those timbers are subjected, their power of resistance as ascertained by experiment, and the scantlings that it is necessary to give them in order to combine the maximum strength with the minimum load upon the supports. In order to do this we must first lay before our readers the theoretical principles upon which the strength of materials is determined.

When a horizontal beam is supported at the two ends and loaded in the middle or any other point with a heavy concentrated weight, or by a weight distributed uniformly over its entire length, the effect upon it is to produce a certain amount of *deflexion*, or bending from the horizontal position; the underside being curved downwards or convex, and the upper one hollowed out or concave. The amount of deflexion is found at first to increase nearly in proportion to the load put upon the beam, but, after a time, the deflexion increases in a greater ratio than the load, until the resistance of the material is at length overcome and fracture ensues. In a beam of uniform strength and of homogeneous material, the place of fracture will be at the middle point between the points of support; but, if one part is weaker than another, as is often the case at a knot in a piece of timber, fracture will generally take place at the weakest point, the actual strength of a beam being only the strength of the

weakest part, however strong it may be elsewhere.

There are two kinds of resistance which a loaded beam offers to the strain put upon it; one is the resistance to bending or flexure, which is termed *stiffness*; the other is the resistance to fracture, which is called the *strength* of the beam. The laws which regulate these two qualities are very different, and a beam may have great *stiffness* and very little *strength*; that is to say, a beam may bend very little under a heavy load, but fracture may take place very suddenly; this is the case with most crystalline substances and what are commonly termed *brittle* materials. On the other hand, we may have a beam that bends sensibly under a very moderate load, and yet its resistance to fracture is so great that it is almost impossible to break it; this is often the case with non-crystalline or fibrous materials, which possess a great degree of what is commonly termed *toughness*.

The laws of the resistance of beams to flexure and fracture have been investigated theoretically by writers on the strength of materials, and as they agree very closely with the results of numerous experiments, we may consider that the truth of them is sufficiently proved for all practical purposes. The law of the *strength* of a beam supported at its two ends and loaded in the middle is that the resistance to fracture is directly proportional to the square of the depth, and inversely as the length of the beam. If the load is uniformly distributed over the whole length of the beam the resistance to fracture is doubled, or the beam will bear twice as great a load when distributed as it will when all collected at the centre before fracture takes place.

The law of the *stiffness* of a beam is that the resistance to flexure is proportional to the cube of the depth, and inversely as the cube of the length. If the load is uniformly distributed, the deflection is to that when the same load is all at the middle, in the proportion of 5 to 8, or the resistance in the former case is eight-fifths of what it is in the latter. Both stiffness and strength are directly proportional to the breadth of the beam. Now as in practical building it is never required to load a floor-beam with a weight at all approaching that which would produce fracture, while it is absolutely necessary that the amount of flexure should be all but imperceptible, it is evident that we may generally leave out of consideration the question of the *strength* of a beam, and confine our attention to the property of *stiffness*, especially as it has been laid down by Tredgold that a floor-beam ought never to be loaded by any weight that will produce a greater deflection in the middle than one-fortieth of an inch to every foot of its length. It is by this rule that we shall be guided in calculating the scantlings of various beams required in the construction of floors.

We have seen that when a horizontal beam is strained by a load at the centre, the under-side becomes convex and the upper one concave, or the fibres at the bottom are stretched or extended, while those at the top are compressed or shortened, and a little consideration will make it clear that the fibres nearest the bottom are more extended, while those at the top are more compressed than those near the middle of the beam's depth. Hence it appears that the fibres near the middle of the beam have very little strain upon them, and add very little to the strength or stiffness of the beam; in fact, they only serve to connect together the upper and lower fibres which really do the effective work. It is by taking advantage of this principle that we are enabled to construct a stronger beam with the same amount of material in the manner described in our former article, and there shown by fig. 6 (page 475, *ante*).

By comparing the theoretical deductions with the results obtained by direct experiment, and adopting the principle stated above, that the deflection of any floor-beam must never exceed one-fortieth of an inch for every foot of length, we obtain the following rule for calculating the depth of a fir joist of given breadth and length. Take three times the cube of the length of bearing (in feet), and divide it by four times the breadth (in inches), and we obtain the cube of the depth in inches, for ordinary floors. For warehouse-floors the cube of the depth should be at least three times as much as that which the above rule gives.

For example, let the bearing be 15 ft. and the breadth 2 in., then the cube of 15 is 3,375, three times which is 10,125, and this, divided by four times 2, or 8, gives 1,266 as the cube of the depth, the cube root of which is nearly 11 in. for the depth of the joists of an ordinary floor. For a warehouse floor we have three times 1,266, or 3,798, as the cube of the depth, the cube root of which is about 15¾; or the depth of joist for a warehouse-floor should be about half as much again as that for an ordinary floor, where the breadth and length are the same.

In a similar way we can obtain a rule for finding the depth of the fir *binders* of a double floor, supposing them to be placed 6 ft. apart: Take four and half times the cube of the length (in feet), and divide it by the breadth (in inches), and we obtain the cube of the depth for ordinary floors; and for warehouse floors take three times the above for the cube of the depth, or else 1½ time the depth with the same breadth. For example, let the length be 10 ft., and the breadth 6 in., then 4½ times the cube of 10 is 4,500, which, divided by 6, gives 750 for the cube of the depth in ordinary floors, or the depth should be 9⅛ in. For a warehouse the cube of the depth will be 3 times 750 or 2,250, or the depth of 13¼ in.; it might, however, be better to increase the breadth to 9 in., when the cube of the depth will be 1,500, which gives 11½ in. for the depth: this will require rather more timber, but saves nearly 2 in. in the depth.

Miscellanea.

Putney's Patent "Nail-less" Solid Wood Flooring. — Visitors to the International Health Exhibition, especially those who are connected with building operations, should make a point of calling at the office of Mr. Samuel Putney, a little to the west of the dairies on the south side of the great corridor devoted to food exhibits. Here (as well as at Baltic Wharf, Paddington, and at his other establishments) Mr. Putney is exhibiting his so-called "nail-less" solid wood flooring. (It is not nail-less, but the heads of the nails do not come near the surface of the floor). The grooved joints are made of different sections to suit the character of various woods. For instance, it has been practically ascertained that one section is the best for flooring prepared from yellow deal, having no acute angles touching the surface, which, in the softer woods, could be easily damaged, while another section is preferable for oak, teak, walnut, pitch-pine, or other hard woods. One good feature about this method of flooring is that it is absolutely essential that the wood from which it is prepared should be thoroughly well seasoned, of the very best quality, and in narrow widths (not exceeding 5 in.). Among the advantages claimed for this method of flooring are the following, viz.:—(1). Cheapness and saving of labour combined with good appearance and durability. (Only one-fourth of the usual quantity of nails required in laying). (2). Air-tight and dust-proof joints (no loose tongues), thus effectually preventing draughts and the penetration of foul gases and unhealthy odours. (3). Nail-less surface (the nails being driven through the patent joints). The floor, presenting a surface of excellent appearance, is suitable for polishing, having no indentations for secreting dirt.

Metallisation of Wood.—By Rubennick's process the wood is steeped in a bath of caustic alkali for two or three days, according to its degree of permeability, at a temperature between 164° and 197° F. It is then placed in a second bath of hydro-sulphate of calcium, to which a concentrated solution of sulphur is added after twenty-four or thirty-six hours. The third bath is one of acetate of lead, at a temperature of from 95° to 122° F., and in this the wood remains from thirty to fifty hours. After a complete drying, it becomes susceptible of a very fine polish, especially if the surface be rubbed with a piece of lead, tin, or zinc, finishing up with a burnisher of glass or porcelain. After all this treatment the wood looks like a metallic mirror, and is entirely unaffected by moisture.

Congregational School for the Education of the Sons of Ministers, Caterham. This building has now been completed, and the building was to be opened this Friday, the 10th inst. A view of the building, and a plan of it, appeared in the *Builder* for Dec. 8, 1883. Mr. E. C. Robins is the architect.

Bronze Alloys for Engineering Purposes.—At a meeting of the Society of Engineers, held on Monday evening last, at the Westminster Town-hall, Mr. Jabez Church, past-president, in the chair, a paper was read by Mr. Perry F. Nursey, vice-president, on "Modern Bronze Alloys for Engineering Purposes." The author commenced by a reference to the age of bronze, and pointed out that, considering the variety of new bronzes there now were, and the extent to which they were used,—superseding in some cases even iron and steel,—the present might be considered as a revival of that age. As the stone age was sub-divided into the old and the newer, so he would designate the present as the newer bronze age. He then briefly referred to the bronzes of the ancients, observing that modern analyses of many of the bronze coins made in different countries and at periods extending over several centuries B.C., brought to light a remarkably close analogy in the proportions of the ingredients. The author then touched on the composition of French bronzes, after which he described the varieties of phosphor bronze (which was invented by Dr. Künzel, of Blazewitz, Dresden, in 1873) and their applications. He then described silicium bronze, which was invented by M. Weiller, of Angoulême, in 1882, and which is especially applicable and is largely used in the manufacture of telegraph wire, on account of its high conductivity. The author then described the manganese bronze, which was invented by Mr. P. M. Parsons, in 1876, and Delta metal, in which iron and copper were successfully and chemically combined by Mr. A. Dick, in 1883. These, the author explained, were the modern bronzes of what he called the primary series, and which were largely used for all kinds of engineering purposes, from a spanner to a screw propeller, and from a boiler tube to a piece of artillery. He then entered upon the consideration of those modern bronzes, which he observed formed a secondary series, in the sense that several of them were more or less but modifications, combinations, or adaptations of those of the primary series. This secondary series includes Otto's phosphor copper; Cockshott's phosphor manganese bronze; Kühne's phosphor lead bronze; Billington's phosphor-tin for bronze-making; Webster's aluminium bronze; and Wiggin's silveroid and cobalt bronze, which were all described, and their special attributes pointed out by Mr. Nursey.

Modern Mummies.—A subject which has important bearings on the vexed question of cremation was broached at the recent meeting of the Social Science Congress, in a paper by Mr. Thomas Bayley, of Birmingham. In spite of much that has been said and written to the contrary, the practice of burning the dead must, in our opinion, and as we have stated elsewhere, lack the sanction of law so long as it does not afford a further guarantee than that required in cases of burial that death has not resulted from foul play. The paper alluded to recognises this difficulty, and proposes a plan by which it may be met. It is the following. The bodies, loosely but completely enveloped in cotton-wool, and placed within air-tight cases, are exposed, in a subterranean gallery lined with cement, to the action of cold air, which is chemically dried, and purified from putrefactive bacteria. After a time dry air at a higher temperature is used in the same way. The result is mummification, the integument remaining white. Bodies which have undergone this process may, it seems, be kept for an indefinite period without evidence of change, if protected from damp; may, if required, be submitted to examination by analysis or otherwise in an adjoining cool and dry mortuary-chamber; may be cremated or otherwise disposed of. Mr. Bayley's plan has considerable merit on the ground of its philosophical ingenuity.—*Lancet*.

Inner Circle Railway.—The Metropolitan and District Companies having completed the working arrangements, the Inner Circle Railway and its extensions to Whitechapel, with the five new stations, viz., Cannon-street, East-cheap, Mark-lane, Aldgate East, and St. Mary, Whitechapel, were opened for public traffic on Monday last. By means of the completion of these railways, the two companies are also enabled to run through trains over the East London Line (of which they are part lessees) to New Cross, there interchanging traffic with the entire systems of the Brighton and South-Eastern Railways.

Deleterious Dyes. — The crusade against aniline dyes has, after a long interval, been energetically revived. It is a notorious fact that in green wall-papers, in articles of clothing (gloves, stockings, and fabrics used for feminine dress and ornament), and in confectionery, aniline is used. Several years ago many obscure cases of arsenical poisoning were traced to arsenite of copper. At that time this compound was largely used as a pigment, particularly for the fancy patterns of foliage in the ordinary cheap bed-room papers. In the process of manufacture the colour was laid on so thickly that it represented nothing less than a mass of solid arsenic, which, under the influence of warmth, was diffused in particles through the room, and breathed by the occupants. Many children, as was afterwards discovered, died from inhaling the poisonous odours. It would seem that lately the objectionable poison,—no longer in the colour of green, against which nearly everybody is on his guard, but in various other tints,—has been re-employed. We are told on high authority that in these cases the poisonous effects arise from the imperfect removal of arsenic, which is used, not as in itself a pigment, but as a reagent in the course of manufacture. Many sensible people, in view of this, are suggesting a return to the pre-aniline stage of manufacture. But the remedy is not to be found in the prohibition of aniline dyes; it lies in the hands of the purchaser of fabrics deleteriously charged with them. The detection of arsenic, as most persons are aware, is one of the simplest processes in elementary analytical chemistry, and at a trifling outlay any chemist will conduct an analysis.—*British Trade Journal.*

The Acton Sewage Scheme.—The Acton Local Board have decided to adopt the A B C system of treating the sewage in connexion with their drainage scheme, which has been planned by Sir Joseph Bazalgette (Engineer to the Metropolitan Board of Works), with the assistance of Mr. Lailey, the Surveyor to the Acton Local Board. A part of the scheme is the laying of a 5-ft. effluent sewer through the parish of Chiswick to the side of the Thames, into which will flow the effluent water. The Chiswick Board, however, have decided to oppose the laying of this sewer on the ground that it is unnecessarily wide, and that its construction will cause needless damage to some of the streets; but the reply of the neighbouring Board is that this width is required to hold the effluent sewage during the back flow of the tides, which it was expected will be considerable at the proposed outflow. It is probable that the dispute will necessitate a Local Government Board inquiry. The general impression in Chiswick evidently is that the Acton Board are proposing to construct this large effluent sewer in view of the prospect of an arrangement being come to with the Metropolitan Board of Works to pay a portion of the cost of its construction, on condition that the Board be allowed to divert the storm-water of Stamford Brook into it, and so relieve the sewage works in the East of London of a considerable volume of water, which increases considerably the pumping expenses of the Metropolitan Board of Works.

A New Screw-driver. — What is claimed to be an improved screw-driver has been patented by the head of an American firm. The screw-driver consists of three parts,—the handle, the bit, and the points. The handle is made of polished rosewood, and is 7 in. in length, and finely finished. It has in it a receptable for the points not in use, which is furnished with a brass cover operated from the other side of the handle, a little pressure on a projecting button slightly raising the cover and permitting it to be easily turned in opening. A spring in the interior of the handle draws the cover down and holds it snugly in place. The handle has also a socket or stock for the reception of the bit, which is secured by a screw. The bit is represented ready to be attached to the handle with one of the screw-driver points fastened to it, being firmly held in place by a screw. This screw can be readily operated by one of the points held in the fingers. These points, of which each screw-driver has six, are intended to be shown in this implement; the points can be turned obliquely to or at right angles with the bit, and the screw thus be successfully driven home; and, third, that the bit can be taken out of the handle and used in a brace.—*Science Monthly.*

Portland Cement, on emerging from the factory, is composed of an almost impalpable powder, mixed with coarser grains, which have but little adhesive quality. The necessity for fine grinding is shown by the fact that the portions that pass through a No. 176 sieve (which has 31,000 meshes to the square inch) have five times the adhesive strength of those that pass through a No. 103 sieve, which has only 10,600 meshes to the square inch. No. 176 is the finest that is made, and will prevent 45·6 of ordinary cement from passing through. Cohesion, it must be remembered, is not adhesion, its force being much greater by from three to ten times. The best test of Portland cement is its adhesive power, although this varies, according to whether the substance is stone, brick, slate, marble, or glass. The No. 176 sieve should prevent 45 per cent. of the cement from passing the sifted portion, which should have an adhesive power of 95 lb.; the unsifted, of 75 lb. per square inch.

New Railway Station at Brimsdown.—The Great Eastern Railway Company have just opened the new Brimsdown Station on the Cambridge line, midway between Ponder's End and Ordnance Factory. The station harmonises in style with the buildings on the adjoining Brimsdown estate.

Science and Art Department. — Mr. Stannus, the lecturer on "Applied Art" in the National Art-training Schools at South Kensington, will commence his course on "Elementary Art" on Monday, the 13th instant, at eleven a.m., and on "Advanced Art" on Tuesday, the 14th instant, at two p.m.

COMPETITIONS, CONTRACTS, & PUBLIC APPOINTMENTS.

Epitome of Advertisements in this Number.

COMPETITIONS.

Nature of Work.	By whom required.	Premium.	Designs to be delivered.	Page.
Crediton Water Supply	Committee	35*l.*	Nov. 22nd	i.
Pier and Landing-stage, Ventnor	Ventnor Local Board	.....	Dec. 8th	ii.

CONTRACTS.

Nature of Work, or Materials.	By whom required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.	Page.
Paving	Willesden Local Board	O. Claude Robson	October 14th	ii.
Repairing Tramways	St. Helen's Corporatn	G. J. C. Broom, Assoc. M.I.C.E.	October 15th	ii.
Masonry	Fulham Board of Wrks	*Official*	do.	ii.
Converting Houses into Shops, at Clapham	.....	Thos. Spearing	do.	xviii.
Church of St. Agnes, Bristol	.....	W. W. Bethell	do.	xviii.
Warming	Malvrn Assembly-rms & Pleasure Grdns., Lim.	J. Johnson	October 16th	ii.
New Post-office, Victoria Docks	Commissnrs. of Works	*Official*	October 18th	ii.
Cast-Iron Pipes	Torquay Local Board	T. S. Weeks	October 20th	ii.
Sewers, Gullies, &c.	Commissionrs of Sewers	*Official*	October 21st	ii.
Road Roller	Acton Local Board	.....	do.	ii.
Tar Paving	Acton Local Board	.....	do.	ii.
Warehouse, Winchester	Not stated	Thos. Stopher	October 22nd	xviii.
Construction of Sewer	Leicester Corporation	J. Gordon, C.E.	October 23rd	xviii.
Steam-Engines, Boilers, &c.	Darlaston U. S. A.	E. Pritchard, M.I.C.E.	do.	ii.
Re-seating, &c., Parish Church, Lyme Regis	R. W. Hillman, Solicitr	Not stated	October 25th	ii.
Enlargement of Post-office, Yarmouth	Commissnrs. of Works	*Official*	October 27th	ii.
Stoneware Pipe Sewers	Swansea U. S. A.	R. H. Wyrill	October 29th	ii.
York Paving	Gravesend Corporation	*Official*	Nov. 1st	ii.
Public Baths, &c., Ealing	Local Board	Chas. Jones, C.E.	Nov. 3rd	ii.
Concrete, Brick, and Pipe Sewers, &c.	Romford R. S. A.	Brundell, Simmons, & Brundell	Nov. 4th	ii.
Alterations to Cottages, New Malden	.....	J. R. Gover	Not stated	ii.
College and Hall, Hampstead	J. Haysman	Banister Fletcher	do.	ii.

PUBLIC APPOINTMENTS.

Nature of Appointment.	By whom Advertised.	Applications to be in.	Salary.	Page.
Borough Surveyor	Grimsby Town Council	October 18th	200*l.* per annum	xvi.
Sanitary Inspector	Longton Town Council	October 27th	100*l.* do.	xvi.

TENDERS.

For the rebuilding of the superstructure and the strengthening of Hammersmith-bridge, and also for the construction of a temporary bridge to be used during the execution of the works to the permanent structure, for the Metropolitan Board of Works. Sir Joseph Bazalgette, engineer:—

J. Mowlem & Co.	£95,300 0 0
W. Webster	94,828 0 0
G. Moss	91,019 0 0
T. W. Chester	89,000 0 0
T. Vernon & Co.	88,783 0 0
Dixon, Appleby, and Thorn*	82,177 0 0

* Accepted.

For the erection of a School to provide accommodation for 1,200 children, on the site in Montem-street (Finsbury Division), for the School Board for London. Mr. E. R. Robson, architect:—

W. Goodman	£17,983 0 0
Patman & Fotheringham	17,878 0 0
Kirk & Randall	17,774 0 0
W. Downs	17,707 0 0
J. Grover	17,338 0 0
W. Shurmur	16,560 0 0
Stimpson & Co.	16,524 0 0
C. Wall	16,429 0 0
Priestley & Gurney	16,398 0 0
W. Bangs & Co.	16,337 0 0
W. T. Niblett	16,299 0 0
S. J. Jerrard	16,107 0 0
Wall Bros.	15,994 0 0
Atherton & Latta	15,990 0 0

For alterations and repairs to Higher Mount, Galpin, Dartmouth, for Mr. W. H. Hawke. Mr. E. H. Back, architect, Dartmouth. Quantities by architect:—

E. J. D. Henley, Dartmouth	£137 10 0
Orlando Veale, Dartmouth	137 10 0
Vaisey & Son, Dartmouth	135 0 0
B. Williams, Dartmouth (accepted)	127 0 0

For new departments to accommodate 910 girls and infants, in lieu of the present Girls' and Infants' Departments, on the site in Edward-street, Deptford, for the School Board for London. Mr. E. R. Robson, architect:—

J. W. Hobbs	£11,400 0 0
Turtle & Appleton	11,094 0 0
J. Grover	10,567 0 0
C. Cox	10,556 0 0
Stimpson & Co.	10,535 0 0
Scrivener & Co.	10,520 0 0
W. Downs	10,484 0 0
Wall Bros.	10,462 0 0
Atherton & Latta	10,400 0 0
W. Bangs & Co.	10,340 0 0
C. Wall	10,330 0 0
H. Hart	10,300 0 0
Lathey Bros.	10,232 0 0
W. Johnson	10,182 0 0
Kirk & Randall	10,114 0 0
S. J. Jerrard	10,039 0 0
W. Oldrey	10,000 0 0
J. Holloway*	9,861 0 0

* Recommended by Works Committee for acceptance.

For Pontypridd Hall, shops, &c. Messrs. James Seward & Thomas, architects, Cardiff:—

D. W. Meredith, Pontypridd	£6,891 8 10
D. C. Jones & Co., Gloucester	6,820 0 0
John James & Co., Swansea	6,165 0 0
William Symonds, Cardiff	6,100 0 0
E. and T. Hatherly, Bristol	5,924 0 0
David Davies, Cardiff	5,895 0 0
William Seaton, Pontypridd*	5,718 18 11

* Accepted.

For alterations at Chase Side, Southgate, for Dr. Vivian. Mr. Arthur W. Saville, architect. Quantities supplied:—

Stevenson	£125 0 0
Kerry	125 0 0
Royal	123 0 0
Newby	99 0 0

For demolition of existing stables and re-erection on the site thereof of new stables, Gascoyne-street, Liverpool, for the Corporation of Liverpool. Mr. Clement Dunscombe, M.A., M Inst.C.E., City Engineer:—

A	£5,861	0	11
B	4,813	17	6
C	4,699	0	0
D	4,550	0	0
E	4,549	0	0
F	4,449	0	0
G	4,440	0	0
H	4,255	0	0
I	4,248	0	0
J (accepted)	4,230	0	0

For roads and sewers on Ferme Park Estate, Hornsey. Messrs. E. E. Croucher & Co., Chancery-lane, surveyors:—

Nowell & Robson	£6,029	0	0
T. G. Dunmore	4,993	0	0
George Bell	4,924	0	0
James Pizzey	4,860	0	0
C. Killingback	4,756	17	6
Thomas Adams	4,530	0	0

For new Sunday Schools adjoining the Wesleyan Chapel, East Molesey. Mr. Charles Bell, architect, New Broad-street. Quantities supplied by Mr. H. Lovegrove, Budge-row, Cannon-street, E.C.:—

J. Holloway	£1,727	0	0
J. H. Jones	1,660	0	0
Wheatley & Sons	1,653	0	0
Oldridge & Sons	1,623	10	6
Smith & Sons	1,619	0	0
J. Piller	1,615	0	0
Allen & Sons	1,606	0	0
F. Higgs	1,520	0	0
Hickenbotham	1,490	0	0
Potterton & Co.	1,426	14	0

[The above amounts include the gallery.]

For rebuilding the Royal Standard Public-house, York-road, Battersea, for Messrs. Sansom and Ewington. Mr. H. I. Newton, architect, Queen Anne's-gate, Westminster. Quantities supplied:—

First Contract.

Hammond, Battersea	£3,100	0	0
Richens & Mount, Battersea	3,036	0	0
Royal, Pen'onville	2,940	0	0
Canning & Mullins, Newington	2,840	0	0
Steel Bros., Dalston	2,698	0	0
Spencer & Co., Knightrider-street	2,650	0	0
Lamble, Kentish Town	2,535	0	0
Godden, Brayanstone-square	2,499	0	0
H. Burman & Sons, Kennington*	2,444	0	0

* Accepted.

For three houses on the Artillery Field Estate, Guildford, for Mr. J. Rose. Mr. A. B. Harding, architect:—

Tribe & Robinson	£963	0	0
T. Downes	940	0	0
Hill & Downes	911	0	0
G. & R. Smith	880	0	0
Banham	787	0	0
Carrington & Peto (accepted)	738	0	0

For the erection of shop and dwelling-house, 74, Marylebone-lane, for Mr. John Spink. Mr. Alfred J. Hopkins, architect, 10, Berners-street, London, W. Quantities supplied by Messrs. New & Son, 62, George-street, Portman-square:—

W. H. Butcher	£1,275	0	0
Adams	1,047	0	0
Tozer	1,025	0	0
Scott	997	0	0
Clark	990	5	9
Ashwell	979	0	0

For rebuilding No. 11, Fore-street, City. Mr. John Slater, B.A., architect. Quantities by Mr. L. C. Riddett:—

W. King & Son	£3,250	0	0
Brown, Son, & Blomfield	3,100	0	0
E. Cock	3,044	10	0
G. S. S. Williams & Son	2,943	0	0
L. H. & R. Roberts	2,928	0	0
J. & J. Greenwood	2,859	0	0
E. Conder	2,846	0	0
W. Downs	2,845	0	0
Patman & Fotheringham	2,773	0	0

[All amounts net after allowing for old materials.]

For erecting cottage at Coed Bell, Chislehurst, for Miss Amos. Messrs. Habershon & Fawckner, architects, Bloomsbury-square:—

Hooper	£338	0	0
Sperring	335	0	0
William Groom, Dulwich	297	0	0

Accepted for new church, Alveston, near Bristol including tower. Mr. Henry Lloyd, architect, Bristol. Quantities supplied:—

Stephens & Bastow, Bristol and London £3,176 0 0

For house and shop for Mr. Harradine, Plashet-lane, East Ham. Mr. Bethell, architect:—

Bricknal	£445	0	0
Baxter	429	0	0
Wyles	424	0	0
Parsons (accepted)	350	0	0

Accepted for the carcase of detached house, St. John's-road, Eastbourne. Messrs. William Reddall & Son, architects and surveyors, 10, South-street, Finsbury, and 86, Terminus-road, Eastbourne:—

Dore & Son (lowest tender) £1,428 0 0

[Highest tender, £1,800.]

For the erection of soiled linen room at the Lambeth Infirmary:—

Chapman	£198	0	0
Baxter	129	0	0
Parker	129	0	0
Robinson & Miler	125	0	0
Lathorn	120	10	0
Dickinson	111	0	0
Hayes	111	0	0
Smith	110	0	0
Aldridge & Jenvey	103	10	0
Cook	103	0	0
Lye	82	0	0

For making-up Palace-road, Crouch End, for the Hornsey Local Board. Mr. T. de Courcy Meade, engineer and surveyor:—

Dunmore, Crouch End	£762	0	0
Brown, Upper Holloway	683	10	0
Pizzey, Hornsey	584	10	0
Jackson & Sons, Finsbury-park	579	0	0
McKenzie & Co., City	575	0	0
Walker, Holloway (accepted)	446	16	8

For new sculpture studios in Vincent-square, Westminster, for Messrs. J. Whitehead & Sons. Mr. John Adams architect:—

H. Beazley, Westminster	£685	0	0
T. Brunsden & Co., Brentford	625	0	0
A. Carman, Richmond	547	0	0
T. Richards, Westminster	536	0	0
A. Garratt, Brixton	535	0	0
Gordon, Kell, & Smith, Chelsea*	510	0	0

* Accepted.

Special Notice.—Lists of tenders frequently reach us too late for insertion. They should be delivered at our office, 46, Catherine-street, Strand, W.C., not later than four p.m. on Thursdays.

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TO CORRESPONDENTS.

A. H. B.—C. B. A.—"Stentor" (your suggestion is not likely to find favour at present, and it is too important a move even to suggest without careful consideration).—F. C. (shall appear).—J. M. (ditto).—J. R.—E. F. B.—E. L. H.—W. B. G. B.—M. B. M. N. (photographs received).—T. M.—D. & Co.—J. K. C. (tracings received).—J. H.—G. S.—E. I. B.—C. and H. (received).—T. & Co. (received).—E. J. W. (cannot reply to your letter, as you give no address).—A. Y.

All statements of facts, lists of tenders, &c., must be accompanied by the name and address of the sender, not necessarily for publication.

We are compelled to decline pointing out books and giving addresses.

NOTE.—The responsibility of signed articles, and papers read a public meetings, rests, of course, with the authors.

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Best Bath Stone.
WESTWOOD GROUND,
Box Ground, Combe Down,
Corsham Down,
And Farleigh Down.
RANDELL, SAUNDERS, & CO., Limited,
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Box Ground Stone
Is the Best for Use in all Exposed Positions, being a well-known and tried Weather Stone.
50,000 feet cube in stock.
PICTOR & SONS, BOX, WILTS.
[ADVT.

Doulting Freestone and Ham Hill Stone of best quality, in blocks, or prepared ready for fixing. An inspection of the Doulting Quarries is respectfully solicited; and Architects and others are CAUTIONED against inferior stone. Prices, delivered to any part of the United Kingdom, given on application to CHARLES TRASK, Norton-sub-Hamdon, Ilminster, Somerset.—Agent, Mr. E. WILLIAMS, 16, Craven-street, Strand, W.C. [ADVT.

Doulting Free Stone
HAM HILL STONE,
BLUE LIAS LIME
(Ground or Lump),
For prices, &c., address S. & J. STAPLE, Quarry Owners, Stone and Lime Merchants, Stoke-under-Ham, Ilminster. [ADVT.

Asphalte.—The Seyssel and Metallic Lava Asphalte Company (Mr. H. Glenn), Office, 38, Poultry, E.C.—The best and cheapest materials for damp courses, railway arches, warehouse floors, flat roofs, stables, cow-sheds and milk-rooms, granaries, tun-rooms, and terraces. [ADVT.

Asphalte.
Seyssel, Patent Metallic Lava, and White Asphaltes.
M. STODART & CO.
Office:
No. 90 Cannon-street, E.C. [ADVT.

J. L. BACON & CO.,
MANUFACTURERS OF IMPROVED
STEAM AND HOT-WATER APPARATUS,
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Private Houses, Churches, Schools, Hospitals, Manufactories, Greenhouses, &c.
OFFICES AND SHOW-ROOMS:—
No. 34, UPPER GLOUCESTER PLACE, DORSET SQUARE, LONDON, N.W.
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N.B.—For Prospectuses and Diagrams, address Stamped Envelope to

P. E. CHAPPUIS, Patentee and Manufacturer, 69, FLEET-STREET, LONDON.

NOTICE.—The POLYGONAL REFLECTOR (Latest Patent) FOR ARTISTIC and PICTURE GALLERIES.
Its construction allows of the angle of light being readily altered so as to reflect in any desirable direction.

N.B.—On View at **HEALTH EXHIBITION** (Eastern Gallery).